Welcome to the 5th anniversary of ANSOLE (2011-2016): INCORE 2016!

Dear ANSOLERs and dear Friends,
It is with a heart full of joy and thankfulness that I welcome you to INCORE 2016 commemorating the 5th anniversary of the African Network for Solar Energy, a historical milestone to us and all those who have been very supportive in the past 5 years.
From its inception on the 4th of November 2010 in Sousse, Tunisia, and its launching on the 4th of February 2011 in Linz, Austria, ANSOLE has defined itself as a platform of exchange of various stakeholders (scientists and non-scientists) who are all devoted to address, through human capacity building, the acute energy problem in Africa using sustainable and environment-friendly energy sources. From the beginning, ANSOLE´s activities concentrated around three main goals:

1. Foster technical and vocational education and training (TVET) in renewable energies (RE) at various skill levels (capacity building)
2. Foster research activities in RE among African scientists and non-African scientists who are directly involved in the training and education of African students and experts (capacity building)
3. Promote and encourage the use of RE in Africa through public awareness raising (public education, sustainable development and economy, environmental protection, etc)

Looking back, I am very proud of our achievements during these years of infancy, despite various adversities that we had to overcome:

* ANSOLE is registered as a NGO in Germany in the name of ANSOLE e.V. (Register of Associations at the Local Court of Jena N°: VR 231505, contact address: ANSOLE e.V., Ebertstr. 14, 07743 Jena, Germany; bank details: Sparkasse Jena-SHK, BIC:HELADEF1JEN, IBAN: DE52803530300018025668)

1

*ANSOLE has presently more than 1000 personal members and 6 institutional members located in 44African countries (Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Chad, Central African Republic, Congo-Brazzaville, Democratic Republic of Congo, Cote d´Ivoire, Djibouti, Egypt, Ethiopia, Gambia, Ghana, Guinée Conakry, Kenya, Liberia,Lesotho, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South Africa, Sudan, South Sudan,Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe) and 29 non-African countries (Albania, Austria, Belgium, Britain, Canada, Chile, China, Czech Republic, Dubai , Estonia, France, Germany, India, Ireland, Italy, Luxembourg, Jordan, Malaysia, Netherlands, Palestine, Portugal, Russian Federation, Scotland, Spain, Sweden, Switzerland, Taiwan,Turkey, and USA)

* With fundings from The *Abdus Salam* International Centre for Theoretical Physics (ICTP) ANSOLE sponsored the (Masters and PhD) studies of 6 female and 6 male African students using its three funding schemes:

- ANSOLE Sur-Place Fellowship (ANSUP)
- Intra-African Exchange Fellowship (INEX)
- Africa-North Exchange Fellowship (ANEX)

Dr Shaimaa Ali Mohamed Ahmed is the first person to complete her PhD using the ANSOLE-ICTP financial support, which led us to organise this event here in Egypt. At this point, I want to thank ICTP for being a faithful companion of ANSOLE since its launching. Beyond the fellowship programmes, ICTP has sponsored 4 scientific events of ANSOLE, including INCORE 2016. It has assisted ANSOLE is many other endeavors…

*ANSOLE has mediated 12 African and 3 non-African students to African and European laboratories or institutions.

* ANSOLE has (co)-organised 10 scientific meetings in Africa (Cameroon 2011 & 2012, Morocco 2013, Tunisia 2013, Kenya 2013, South Africa 2013, Ghana 2014, Algeria 2015, Tanzania 2015 and Egypt 2016)

* ANSOLE has assisted in the organisation of non-ANSOLE RE events worldwide (Hamburg 2011, Giessen 2012, Brussels 2012, Istanbul 2013, Berlin 2014, Dresden 2014, Accra 2014, Nairobi 2014 & 2015, etc)

* ANSOLE has disseminated RE related information through its websites (first ansole.com, then ansole.org and baleware.org) news organ (3 issues of ANSOLE News in 2014 and 1 issue of ANSOLE e-Magazine in 2015) and radio and TV broadcasts.
* etc

ANSOLE was capable of such achievements through the active and voluntary engagement of a long list of our members and friends, to whom I am extremely grateful. I am also very grateful to those who supported us by sponsoring our past and present events and to the few ANSOLERs who acquitted their yearly membership due of 20 or 30 Euro.
I am forseeing a bright future for ANSOLE because a dynamic network like ours is expected to play an important role in the implementation of the Sustainable Development Goals (SDGs) (2016-2030) and contribute to achieve the goal set at COP21 in Paris.

I invite you all to actively participate to our activities, to come up with new ideas how to improve our actions, and to be ambassadors of the network around you!

2

I want to end by thanking God for making and keeping ANSOLE an open door of blessings to Africans and non-Africans. I am convinced that with His Guidance and Grace, we shall be able overcome future obstacles in the next 5 years and will bring ANSOLE to new heights!
Stay blessed



Daniel Egbe, ANSOLE Coordinator



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Prof. Daniel A. M. Egbe
(ANSOLE Coordinator & International Organizer)



Prof. Daniel A. M. Egbe was born in Mambanda Cameroon on May 20, 1966. He received his Bachelor of Science degree in Physics and Chemistry in 1991 from the University of Yaoundé, Cameroon. In 1992, he moved to Germany where he obtained a Master of Science degree and a Doctor of Philosophy degree in Chemistry in 1995 and 1999, respectively, from the Friedrich-Schiller University of Jena. He completed his Habilitation in organic chemistry at the same institution in 2006.

From 2006 to 2008, he spent postdoctoral stays at the Max Planck Institute for Polymer Research in Mainz, Germany, the Technical University of Eindhoven in Holland, and at the Technical University of Chemnitz, Germany. Since 2009, he researches and lectures at the Johannes Kepler University Linz. Egbe's main research interest is the design of semiconducting materials for optoelectronic applications.

He is a member of the German Chemical Society (GDCh), Organic Electronics Association (OE-A), and a board member of the World University Service (WUS). Egbe is the initiator of the German-Cameroonian Coordination Office, initiator and international coordinator of the African Network for Solar Energy (ANSOLE), initiator and chairperson of ANSOLE e.V., an institution legally representing ANSOLE, and initiator of the Cameroon Renewable Energy Network (CAMREN). In May 2015, he initiated the research platform BALEWARE (Bridging Africa, Latin America and Europe on Water and Renewable Energies Applications).

Since 2012 he coordinates the ICTP (The *Abdus Salam* International Centre for Theoretical Physics)-ANSOLE fellowship programs. In 2015 he was an independent evaluator for the World Bank Group in higher education issues and was appointed member of the scientific council of the newly created "Ecole Supérieure des Métiers des Energies Renouvelables (ESMER), in the Republic of Benin. He is part of the team developing research programs at the Pan African University Institute of Water and Energy Sciences and Climate Change (PAUWES) in Tlemcen, Algeria. He has published more than 100 peer-reviewed articles and coauthored a book on renewable energy in Sub-Saharan Africa. He speaks more than 5 languages, is married, and is father of 4 children. Email: Daniel.egbe@ansole.org, sykpe: danielegbe1

One- and Two-Dimensional Conjugated PAE-PAV Copolymers: Effect of Laterally Grafted Alkoxy Side Groups on Charge Transport and Photovoltaic Properties

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Abstract

Since the discovery of electrical conductivity in doped polyacetylene by Shirakawa et al.,[1] enormous progress has been achieved in the design, synthesis and detailed studies of the properties and applications of π-conjugated polymers.[2]
Poly(arylene-ethynylene)-*alt*-poly(arylene-vinylene)s (**PAE**–**PAV**s) constitute a class of conjugated compounds combining the intrinsic properties of both poly(arylene-ethynylene) **(PAE**) and poly(arylene-vinylene) (**PAV**) into a single polymeric backbone with additional structure-specific properties. On the one hand, they exhibit red-shifted absorption and emission spectra as well as an enhanced solid state photoluminescence quantum yield as compared to **PAE**s and, on the other hand, they show enhanced backbone rigidity and higher electron affinity as compared to **PAV**s, which is reflected by low turn-on voltages of light-emitting diodes and higher open circuit voltages of organic solar cells manufactured with the help of these materials.[3]
To render such materials soluble, thus processable into thin films for various applications, alkoxy side groups are grafted laterally to the conjugated backone. We demonstrate that, beyond the solubilising function, the side groups can be utilized to efficiently tune the optical, electrochemical, transport, and photovoltaic properties of one-and two-dimensional conjugated **PAE-PAV**s.[4]

6

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Invited Talks

7

Prof. Mady Elbahri



Prof. Dr. Mady Elbahri, obtained a B.Sc. in Chemistry from Cairo University, Egypt, and his M.Sc. in Polymer Chemistry from the Technical University of Clausthal, Germany. He then moved to the Faculty of Engineering at the University of Kiel where he received his PhD in 2008 “with highest honors” in the field of nanotechnology. He has been honored with the “Nano Science Award” of the Federal Ministry of Education and Research (AGeNT-D/BMBF) among others. In 2009 he was granted a Helmholtz-University Group of Academic Talents. Elbahri is the head of the Nanochemistry and Nanoengineering group located at the Institute of Polymer Research at Helmholtz-Zentrum Geesthacht and at the Institute for Materials Science at the University of Kiel in Germany as well as School of Chemical Technology, Aalto University (former Helsinki University of Technology) in Finland. Mady Elbahri holds more than 15 patents in the U.S.A., Europe and Germany. He works in new fields of research and establishes new aspects of nanosynthesis, nanocoating, nanocomposites, and nanooptics, along with the development of several devices using chemical and physical methods.

8

Macroscopic Optical Antennas with Glassy Disordered Dipolar Composites

Mady Elbahri[a, b, c]

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Abstract

During the last years, there has been increasing interest in functional nanocomposites due to novel applications ranging from sensors and plasmonics through stretchable electronics and smart coatings to energy conversion and human health. In this context a dipolar composite with a cooperative macroscopic action has not been suggested so far. The present talk aims at introducing a particularly promising new class of functional optical materials based on natural and artificial dipoles embedded in a polymeric/dielectric host where the unique properties arise from the strong and cooperative near field coupling between neighbouring dipoles, which gives rise to cooperative action thus determining the macroscopic properties. Examples involve transparent conducting metal coatings, perfect plasmonic solar absorbers, and active plasmonic and photoswitchable composites.

Acknowledgements – Financial support by the Initiative Networking Fund of the Helmholtz Association and DFG within the Collaborative Research Centers SFB 677 are acknowledged.

Prof. Nowshad Amin



Dr. Nowshad Amin is a Professor at the Dept. of Electrical, Electronic & Systems Engineering of The National University of Malaysia (@ Universiti Kebangsaan Malaysia), where he also leads the Solar Photovoltaic Research Group at the Solar Energy Research Institute (SERI). After the higher secondary education from native country Bangladesh with distinction, he received the Japanese Ministry of Education (MONBUSHO) scholarship, where he achieved a diploma in Electrical Engineering (1994) from Gunma National College of Technology, Bachelor (1996) in Electrical & Electronic Engineering from Toyohashi University of Technology, Masters (1998) and PhD (2001) on solar photovoltaic technology from Tokyo Institute of Technology (Tokyo, Japan). His areas of expertise include Microelectronics, Renewable Energy, Solar Photovoltaic Applications and Thin Film Solar PV Development. Additionally, his research focuses on the commercialization of Solar Photovoltaic Products from his patented entities; as such he is also serving as the CTO of a University Spin-off company financed by the Malaysian Technology Development Center (MTDC). He has been serving as the project-leader as well as co-researcher of many government (Malaysia) and international (Saudi National Grant, Qatar Foundation etc.) funded projects. He has authored more than 200 peer-reviewed publications, a few books and book chapters. He is actively involved in promoting Renewable Energy to the developing countries in South and South East Asia, working as many committee members as well as an enthusiastic promoter for the affordable solar photovoltaic technologies.

Prospects of Solar Photovoltaic (PV) Technology for a Greener Earth

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Needless to say, we have been blessed by sunlight as well as by the rigorous efforts of the researchers and scientists who have been working on solar cells since its birth. Attributing to the fact, mega to giga-watt-peak level solar farms are no more dream today with very low LCOE (levelized cost of energy). Even though the first generation solar cells (mainly crystalline or multicrystalline silicon based) are still dominating, the quest for other options showed many other potential candidates such as amorphous silicon, cadmium telluride, copper-indium-suphide etc. since early 70s of the last century. Ever since the second generation solar cells came into the scenario, most of these are thin films based which require many supporting layers to form the complete cells in homo or hetero junction configurations on glass, polymers or metals. Many of these are now in commercialization stages whereas laboratory scale conversion efficiencies continue to mark over 20% till present (e.g. CIGS, CdTe). The talk will introduce the huge potential of solar Photovoltaic (PV) as the front-runner renewable energy (RE) source among other options. Chronological development of PV technology including implementation potential will be presented. Successful stories of PV implementation around the globe will be shown to have a long-run trust in our future energy mix model with this green energy resource to have a greener Earth.

11

Prof. Dieter Meissner



Prof. Dieter Meissner obtained his PhD at the University of Hamburg in Germany. He is a Professor of Sustainable Energetics at Tallinn University of Technology, Estonia. He is also a FH-Professor of eco-energy technology at the University of Applied Sciences in Wels, Austria; Chief Scientist at Crystalsol GmbH, Austria and Crystalsol OÜ, Estonia.

Meissner's main research interests are photoelectrochemistry, photovoltaics, and materials research and development.

Meissner published more than 170 papers in top refereed scientific journals, and 150 papers in proceedings volumes. He has more than 150 patents. He edited and co-edited two books.

During his academic career, Meissner developed two universities curricula: the eco-energy engineering curricula at the University of Applied Sciences, Austria, and the sustainable energetics curricula of the international master course of both Estonian universities, Tartu University, and Tallinn University of Technology.

He taught at many universities, including: the University of Hamburg, Germany, Osaka University, Japan, University Buenos Aires, Argentina, Technion Haifa, Israel, Linz University, Austria, and Tallinn University of Technology, Estonia.

Meissner is the initiator, founder and co-founder of five universities spin-out companies, namely AQR consulting, Wels, Austria, ALPPS Fuel Cell Systems GmbH (fuel cells), Graz, Austria, Solar Surface (Selective Absorbers), Linz, Austria, crystalsol OÜ (PV solar cell powders), Tallinn, Estonia, crystalsol GmbH (PV modules), Vienna, Austria.

Teaching Sustainable Energetics

Dieter Meissner[a], *Peter Burk[b], Ilmar Koppel[b], Enn Lust[b], Enn Mellikov[a], Andres Öpik[a]*

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Whereas it took decades to even establish some principles of sustainability in western economics there is not enough time to follow this path for developing countries. Here industrialization has to happen already in a sustainable way. Therefore engineers, playing a central role in this process, have to be educated on the most advanced level possible.

Since until 2050 power supply based on fossil energy carriers has to be replaced by CO2-free means, which means basically by solar energy. So, energetics, the "the study of energy under transformation" (Wikipedia), plays a key role. However, a profound understanding of energy and its sustainable use is still rudimentary in science and engineering. Whereas individual energy conversion devices such as solar cells, wind energy converters or pumps are highly efficient, energy utilization systems such as hydraulic systems installed in industry allow reduction of energy input by 80 to 90 % when optimized [1]. But the problem starts even earlier when trying to define "energy" itself or to explain, why electricity production from thermal energy reaches far less than 50 % efficiency while electricity generation in hydro power plants is at least twice as efficient.

A profound understanding of the theoretical basics of energetics as well as system thinking and analysis are needed to really understand and handle energy in an optimized way. Additionally, environmental, social and institutional knowledge is needed to design "sustainable" energy systems. Here a new "breed" of engineers is needed, generalists rather than specialists, but at the same time understanding the fundamentals of engineering to really talk to the specialists and use their knowledge to optimize systems.

In order to further develop these ideas a new curriculum fit for a University of Applied Sciences in Austria was developed by one of us, and then we designed a University curriculum specializing on materials science for energetics for both Estonian Universities, Tartu University and Tallinn University of Technology [2]. After a few year of experience, an analysis of our achievements is given together with ideas how to implement corresponding curricula in developing countries in order to create the knowledge base for a sustainable development of industry and society worldwide.

Key words: Sustainability, Energy, Energetics, Education

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Solar Energy Conversion Using Powder Materials: A New Technology to Save Our Climate

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Saving our climate, i.e. stabilizing the greenhouse gas induced temperature rise in our atmosphere to below 1.5 °C, requires to reduce the use of fossil fuels to zero until 2050 and therefore produce about 30 TW of power needed worldwide by CO_2-free energy technologies. Thereby also the ecological footprint will be reduced considerably, so that a sustainable future for our life on a limited planet may become possible. Fortunately, the technological potential of solar energy of estimated 600 TW is by far large enough to cover the world's power demand. However, for further price reduction new technologies should be developed, of which the powder printing technology explained here is very promising. This technology also allows for the direct production of hydrogen in photoelectrochemical cells, ideally suitable to produce fuels for the transportation sector or for long-term energy storage.

Assuming that half of the world power supply of 2050, i.e. 15 TW, would have to be provided by photovoltaics, about 100 TWp of PV modules will have to be installed, assuming an average capacity factor of 15 %. With a lifetime of 30 years this requires an annual production rate of 3 TWp/a or 1-3 km^2/hour for an assumed future PV plant efficiency of 20 %. In other words: 830 production lines would have to produce photovoltaic modules with an output of 1 m^2/s, i.e. about 3.6 GWp. Therefore, in order for a substantial contribution of photovoltaics to a global power supply very fast, large scale and low-cost production methods need to be developed. Here powder technologies may be the ideal solution to combine this requirement with high module efficiencies, as will be shown in the talk) [1].

Our research group at Tallinn University of Technology in Estonia, besides supporting the TUT spin-out company Crystalsol in improving its monograin layer PV production, develops and investigates the direct conversion of solar energy into chemical energy in photoelectrochemical devices using ionically conductive monograin membranes [2,3].

Key words: Photovoltaics, photoelectrochemistry, hydrogen, ionic conductivity, composites, hybrid material.

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Employment of Liquid Crystals, Conducting Polymers and Nanoparticles for some Organic Electronics Applications

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Liquid Crystals (LC) are highly nonlinear optical materials and they are sensitive against optical, electrical and magnetic fields. This sensitivity could be exploited for various device designs. In the scope of this presentation, I will firstly discuss the diffraction grating experiments, which are indeed base experiments for holographic data storage and principally information could be stored at the order of Terabyte per cubic centimeter via this approach. Actually it was experimentally observed and shown that dye and carbon nanoparticles doped LCs are promising candidates as storage mediums via Holography.

Second case study is devoted to another critical experimental demonstration that proves the reorientation and conservation of Carbon Nanotubes (CNT) in the structure of nematic LC. Experimental concepts propose this CNT reorientation, which is of critical importance for potential CNT applications, via electrical, optical and magnetic fields.

Third case study is a Hybrid Solar Cell, which is designed and proposed as a feasible and reasonable alternative, according to acquired efficiency with the employment of zinc oxide (ZnO) nanorods and ZnO thin films at the same time. Both of these ZnO structures were grown electrochemically and poly(3-hexylthiophene) : phenyl-C61-butyric acid methyl ester; (P3HT: PCBM) was used as an active polymer blend, which was found to be compatible to prepared Indium-Tin-Oxide (ITO) substrate base. This ITO base was introduced with mentioned ZnO structure in such a way that, the most efficient configuration was optimized to be ITO/ZnO film/ ZnO nanorod/ P3HT: PCBM/Ag. Efficiency of this optimized device is found to be 2.44 %. All ZnO works were carried out electrochemically, that is indeed for the first time and at relatively lower temperatures.

Forth one is an Organic Field Effect Transistor (OFET) device, which was prepared by a side chain thiophene based-dielectric gel copolymer and it shows a higher field-effect mobility and lower threshold voltage. The device is a sandwich type and promising results could be attributed to the compatibility that comes from the similarity between the chemical structures of semiconductor and dielectric layers due to π-π interactions caused by intermolecular overlapping of p orbitals in aromatic thiophene groups existing in both layers. This proposed device which was prepared with poly(MMA-*co*-MTM) has a field-effect mobility of **0.57 cm^2/Vs**, a threshold voltage of **-0.20 V**, on/off current ratio of **10^3** while the device prepared with just PMMA has a field-effect mobility of **0.38 cm^2/Vs**, a threshold voltage of **-0.26 V** and on/off current ratio of **10^2.**

Keywords: Nematic Liquid Crystals, Holography, Carbon Nanotubes, ZnO Nanorods, Solar Cells, Organic Field Effect Transistors.

Prof. G. D. Sharma



Professor G. D. Sharma received his Doctor of Philosophy degree in physics from the Indian Institute of Technology, India.

In 1985 Shama joined the Jai Narian Vyas University, India as an assistant professor and was later on promoted to become a professor. During the period from 1990 to 1991, he was a postdoctoral fellow in the field of organic photovoltaic devices at the Department of Electrical Engineering, Rutgers University, U.S. Currently; he is working as director of the JEC group of Colleges, Jaipur Engineering College, India.

Sharma's research area includes organic solar cells based on conjugated polymers, small molecules, and dye sensitized solar cells.

He has published more than 210 research papers in international journals. He has completed many research projects funded by the Indian government and joint international projects with Greece, Spain, South Korea, United Kingdom, Russia, and Japan. He has also supervised 16 Ph.D. students.

Sharma is a visiting professor at many international universities and research institutes. He had frequently visited many countries like U.S., Greece, Spain, Switzerland, France, Japan, Singapore, Egypt, U.K., South Korea, Austria, Portugal and Finland, and delivered many invited lectures.

Recent Advances in Organic Bulk Heterojunction and Dye Sensitized Solar Cells: From Materials to Devices

G. D. Sharma

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Organic solar cells and dye sensitized solar cells based on conjugated functional materials including polymers and small molecules have attracted much attention due to their diverse advantages such as low cost, wide material resources and large area preparation. The most structure used for organic solar cells is bulk heterojunction solar cells (BHJOSCs) , in which a blended active layer consists of donor and acceptor materials is used. The power conversion efficiency of BHJOSCs has been reached more than 10 % based on low bandgap polymers and small molecules, in recent years.

The dye sensitized solar cells based on metal free dyes showed a PCE of more than 13 % at low cost of fabrications. More recently, perovskites have been used as sensitizers for this type of solar cells and achieved the power conversion efficiency more than 17 %, in recent years. These developments on the organic solar cells, dye sensitized solar cell and organic-inorganic perovskites solar cells, open a new research area for physicists, material scientists and engineers.

This lecture deals with the recent developments in the field of materials used in organic solar cells, dye sensitized solar cells and perovskites solar cells, device architecture, influence of different processing conditions on the performance of devices.

17

Light Trapping and Plasmonics in Self-Organised Media

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Recently, the integration of nanostructured interfaces with tailored optical functionality into thin film solar cells has been proposed with the aim of enhancing photon harvesting. The talk will highlight recent results relative to the self-organised formation of arrays of metal-dielectric nanostructures induced by ion beam sputtering (IBS) and glancing angle deposition on nano-textured dielectric templates.The templates represent a natural playground for the confinement of metal nanostructures in view of plasmon enhanced photon harvesting and spectroscopies [1-5]. At the same time the high aspect ratio dielectric features confer broadband anti-reflection functionality and Haze to the textured glass substrates a feature which has been exploited for increasing light trapping in nanostructured thin film PV devices [6,7].

Keywords: Nanostructured materials – Plasmonics - Light trapping - Transparent Electrodes - Nanowires

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18

Oral Presentaions

Topic 1

19

Renewable Energy

Design of a pyrolysis reactor for biochar production for 'motocharcoal' briquettes

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Zimbabwe is an agro-based country and, as a result, produces a lot of agrowaste i.e. about 70 000 tonnes annually in the form of waste cornstover, bagasse and sawdust which are currently not being utilized. There is potential for conversion of this agriculture waste to charcoal briquettes using the slow pyrolysis technology which increases the briquettes heating value. This paper presents a design for a pyrolysis reactor that can be used for conversion of agricultural waste to biochar which can then be used to make, "Motocharcoal" which is a trade name for the densified charcoal briquettes that are currently being made in Zimbabwe. It is an ecofuel that can be used for heating and cooking purposes with a heating value of 22.5 MJ/kg. The pyrolysis reactor design was carried out based on an operating capacity of 12 tons/hr for an 8 hour working period based on the availability of the raw material which was mainly cornstover with a density of 200 kg/m^3. Pyrolysis took place under anaerobic conditions to enhance carbonisation. This was done at a temperature of 300 °C and a retention time of 3 hours to increase the calorific value of the biochar before briquetting. A conversion rate of 70% from agrowaste to biochar was achieved. The pyrolysis reactor should be made up of stainless steel. Temperature and pressure were identified as the critical process parameters that must be controlled as these affect the quality of the biochar which inturn affects the briquettes quality. The pyrolysis reactor volume was 15.3 m^3 with atmospheric pressure as the working pressure and a design pressure of 14.9 MPa. Glass fibre must be used as the insulation material to minimise heat losses and water used as the cooling agent. The designed pyrolysis reactor will ensure optimal cornversion of the agrowaste to biochar for high quality briquettes.

Keywords: Agrowaste, biochar, briquettes, motocharcoal, pyrolysis reactor design

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Design, simulation and economic analysis of PV power plant with a new technique for solar tracking system using solar-powered Stirling engine by MATLAB

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This paper presents the design and simulation model for a photovoltaic power plant using Matlab/GUI. The design and the model for a power plant take into consideration effects of the power consumptions for solar tracking system using solar-powered Stirling engine and compare the new technique for tracking with the last types in this field. The new system designed here produced good power output performance. In addition, this study attempts to demonstrate economic potential of this type of systems by Stirling engine as an option for the power source for Photovoltaic tracking systems and apply it in different locations in Egypt. Hence, the present analysis provides a theoretical guidance for designing and operating of the PV power plant, as well as estimating output power from the power plant and the best location in Egypt. From the economical point of view, this methodology can be useful for local authorities and expected that solar systems will be very competitive to those who have to authorize the installation of the new power plant which is trying to find the suitable locations from the point of view of economical impact.

Keywords: Photovoltaic; Tracking; Stirling; Matlab

21

The Photovoltaic Solar Energy in Algeria: the Reality and Prospects

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Abstract

The size of the Algerian Sahara could capture enough solar energy to meet the entire world's electricity needs, according to Mr. Kaveh Zahedi, Deputy Director, UNEP's World Conservation Monitoring Centre, based in Cambridge [1]. *This is* one of the main reasons, which led our country to a significant launching program to develop renewable energy based on photovoltaic solar energy, which aims to produce from renewable sources 12,000 megawatts, which will cover 40% of the nation's energy consumption by 2030 [2]. The Algeria program consists of installing up to 22 000 MW of power generating capacity from renewable sources between 2011 and 2030, of which 12 000 MW will be intended to meet the domestic electricity demand and 10 000 MW destined for export. [3]. To achieve this goal, the Algerian government act on several axis including legislative and regulatory texts, institutional framework and industrial capacities to build in order to back up the program.

Keywords: photovoltaic, solar energy, Algeria program.

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Network Operation System for Renewable Energy Resources with Added Capabilities via an Immersive Virtual Environment

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As new energy sources are beginning to spread in developing countries, there is a need to track and monitor them. Moreover, there is a need to control the operation of these renewable energy resources. The monitoring and control system can range from simple on-site computerized maintenance terminal to a full network operation center (NOC) on the scale of city or even the whole country. The NOC will be connected to the energy source controllers via some network connection. The controller will then connect to the sensors in the power system and convert the digital data to sensor signals (and vice-versa).
The network infrastructure is used to connect the on-site controller(s) with the network control center(s). The communication can be based on wired or wireless media. Examples include leased telephone lines, WAN circuits, licensed and unlicensed radio, cellular, microwave, or even satellite for remote areas that have no network coverage.
An immersive virtual environment represented by a practical virtual world implementation is incorporated. Through the virtual world, it is possible to add visualization combined with other virtual world abilities such as avatar collaborative interaction. The benefits and potential of adding an immersive environment is shown in relation to state of the art and how it can contribute to increase awareness and education (for example by visualizing energy production), from the end-user perspectives about energy consumption patterns and thus energy saving practices.

The main purpose of the work is to come up with a computerized tracking, monitoring and control system for the renewable energy sources. The system contains a database of the available energy sources and their capacity data. The system is capable of providing information about the usability and availability of the energy sources.

Keywords: renewable energy; network operation center; network connectivity; immersive environment

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Statistical analysis of hourly Wind Speed Data from Some Burundian Stations using Beta Probability Density Functions

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A 4-years period's hourly wind speed (v) data from four stations in Burundi have been statistically analyzed in this paper. Attempts have been made to fit relative frequency distributions of those data with beta probability density functions (β – PDFs), which are quite different from Weibull PDFs commonly met in that kind of analysis. For that effect, the v quantity has been replaced by the relative wind speed ($v_r = v/v_{max}$), the values of which range from 0 to 1. β – PDFs fitting the observed monthly relative frequency distributions of the relative wind speed have been implemented for the twelve v_r data sets of each station. For each v_r data set, the effectiveness of the fitting process has been checked through three statistical tests, namely the mean bias error (MBE), the root mean square error (RMSE) and the t – statistics. For any of the 48 v_r data sets, the MBE and the RMSE have been found equal to or close to zero, and t was lower than its critical value ($t_c = 3.250$ for a confidence level $\gamma = 99.5\%$ and a number of degrees of freedom n-1=9). All the theoretical formulations (β-PDFs) developed in this work are therefore very good fits of the observed v_r monthly relative frequency distributions. Moreover, contrarily to the Weibull PDFs, those β-PDFs accurately represent the probabilities of observing zero or very low wind speeds. They should thus be used as input data in the design of wind energy conversion and/or storage systems at the stations of this analysis.

Keywords: β-PDFs, MBE, Relative frequency distributions, RMSE, Relative wind speed, t–statistics.

International Science Programme at Uppsala University: Support to Postgraduate Education and Research Capability Strengthening for a Sustainable Development

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A particular and unique aspect of the internationalization efforts of Uppsala University is the collaboration and cooperation with least developed countries in Africa, Asia and South America. This is accomplished through the International Science Programme (ISP), a special unit that has, since 1961, successfully [1] worked with low-income countries **to strengthen their domestic research capability** within the chemical, physical and the mathematical sciences.
The strengthening and building of post-graduated education and research capability are fundamental steps for the development of a knowledge-based society and for a sustainable fight against poverty, enabling people to improve their life conditions. ISP aims at creating sustainable research groups/networks working with projects of strong local ownership offering long-term and untied support.North-South and South-South collaborations are important components of ISP's approach, allowing students and researchers to get access to international education and scientific environments as well as to international networks of expertise.
In my presentation, I will illustrate ISP's mode of operations and I will describe how students from South can join the research and education programs on sustainable development at Uppsala University.

25

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On the Path to Sustainable Development: Green Mini Grids and Our Energy Future

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The concept of mini-grids has been around for decades. Mini-grids have been advocated by development scholars and energy specialists as a viable means for increasing access to energy in a bid to increase economic activities and promote economic development. Especially in African countries where the rural populations with access to stable modern electricity on average is less than 5%, mini-grids can play an important role in developing localised energy systems to promote sustainable development. Over other forms of mini-grids, green mini-grids (GMGs) by their structure and design present a compelling case for preference. GMGs can be situated at any point in localised areas since they utilize solar energy. Additionally, in generating electricity to power dispersed communities, GMGs can also feed excess electricity into the national grid – when appropriate agreements to allow for this are in place. Importantly, by operating GMGs, African countries can help to reduce the emission of greenhouse gases known to be responsible for climate change, while reaping the economic benefits of having stable modern electricity. In most African countries, the rural populations surpass the population of urban dwellers. By generating electricity for economic activities, GMGs can help to energize rural economies to the point where these economies operate in their full economic potential. Essentially, African countries can plot their paths to sustainable development by promoting GMGs within rural areas. However, despite the clear benefits, a host of challenges surrounding energy planning and development has prevented the widespread promotion of GMGs in Africa. Some of these challenges include financial impediments, the lack of appropriate policy and regulatory structures, increasing perceptions of technological failures leading to a negative bias for GMG development and the absence of adequate data to map the energy needs of dispersed rural communities. These challenges contribute largely to the under-utilization of GMGs and the consequent stagnation of energy systems in many African countries. In order to unlock the potential of GMGs so as to drive the development of rural economies, proper business models that specifically address local energy challenges should be developed. In addition, appropriate operator models for GMGs should also be established and supported. Importantly, a mini-grid policy and regulatory framework that defines the objectives for GMG development which is integrated into the national energy development plan should be implemented. Finally, for the development of GMGs to be successful, the policy and regulatory framework should address critical financial challenges such as tariffs for electricity produced by GMG operators through small power producer agreements (SPPAs) in order to attract investment for GMG development.

Key words: Green mini-grids, sustainable development, finance, policy, Africa

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Optimal Design of Two Secondary Optical Elements for concentrated photovoltaic: truncated Pyramid and Cone Concentrators

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Morocco has defined an energy strategy to reduce its energy dependency and to protect the environment. This strategy is projected to establish 42% of total installed capacity from renewable energy. To achieve this goal several technologies are envisaged, among of them the concentrated photovoltaic (CPV). A concentrated photovoltaic is generally composed of a primary optical element (POE), a secondary optical element (SOE) and a solar cell. The SOE can be effective in redirecting the sunlight into the solar cell as well as improving the energy uniformity on the solar cell. In this work we present a parametric design of two secondary optical elements (SOE): the cone and the truncated pyramid. We examine the influence of variation of the acceptance angle **θ** and the angle opening of the pyramid and cone α on the design of the two concentrators. Also we calculate the maximum number of reflections that sunlight could make before exiting each concentrator. Ray tracing technique was used to compare the optical characteristics (i.e., acceptance angle, optical efficiency, and irradiance distribution) of concentrators. The study is conducted with the concentrators which the bottoms are set at 5mm, usual size of photovoltaic receivers.

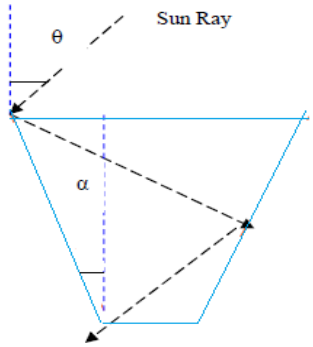


Figure 1: Side view of the concentrator

Keywords: concentrated photovoltaic; secondary optical element, optical efficiency, acceptance angle, irradiance distribution.

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Developing an Off-Grid Model for Power Supply and Wastewater Treatment in the 1.5 Million Feddan Project in Egypt

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In June 2015, the Egyptian governement had announced the establishment of the "1.5 Million Feddan Reclamation Project" as a part of its developmental plan. The project is located in 10 different sites in the Egyptian desert, with each site having both residential and agricultural zone. Groundwater is planned to be extracted for both irrigation and drinking uses, but establishing wastewater and power networks may need huge investments with low cost effectiveness, due to low population density expected in these settelments.This paper introduces an off-grid model for power generation and wastewater treatment using the privilege of hot climate and high sun exposure in the Egyptian desert. The model develops sustainable methods applied in many Asian and African developing countries, with modifications to suit the Egyptian use. This model can provide sustainable and economic utilities which can be applied in the Million Feddan Project as well as any similar remote housing project in new settlements in Egypt.

Keywords: Off-Grid Utilities, Million Feddan Project, Wastewater treatment, Power generation, Egypt.

28

Photovoltaic Solar Water Pumping: A Complement to Usual Irrigation Systems in the Ziz Valley (South East of Morocco)

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Solar photovoltaic pumping systems are suitable for the Oued Ziz Valley (OZV) because the already drilled wells are not very deep, and the solar energy can reach 7.5 kWh/m^2/day during May-September period almost without a cloudy day. Outside this period the cloudy days are rare. Wind pumping systems are not suitable due to the irregularity and low wind speed. Late spring, summer and beginning fall is the main period where we need to pump underground water for irrigation purposes. Outside this period water from the river may supply the necessary amount via a traditional irrigation system based on small local dams and "saguias".
The cost of 1m^3 water pumped with solar PV system in the OZV was calculated for two periods (July-August, and full year). We have seen that the solar PV pumping is competitive with diesel pumping for the OZV. A transportable solar PV pumping system may help to lift the needy shallow water left in the river during summer dry periods. In this paper we will discuss and present the technical and financial problems encountered by the rural population in OZV, to find a suitable solar water pump. The environmental and financial gain when using solar water pumps instead of oil engines will be also addressed. The results obtained may be extended to similar dry and semi-dry south Mediterranean areas.
Keywords: Photovoltaic, environment, dry area, water

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Etat des lieux et perspectives sur les énergies renouvelables en Afrique centrale: laboratoires, équipes de recherche et experiences

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Le présent travail donne l'état des lieux et les perspectives des energies renouvelables en Afrique centrale. Les gouvernements se sont intéressés parce que les énergies renouvelables touchent plusieurs secteurs en occurrence l'electricité, l'agroalimentaire, l'urbanisme. Les Universitaires font du développement des technologies des énergies renouvelables leur cheval de batail pour résoudre les problèmes de pertes post- récoltes. Dans cette partie d'Afrique, la source d'énergie solaire vient en premier lieu pour le séchage et on peut y trouver les séchoirs solaires type traditionnel, direct, indirect, mixte et hybride ; ensuite on peut avoir la source d'énergie biomasse et enfin la source électrique conventionnelle. Les thématiques de recherche dans les équipes de recherche sont axées sur le développement des technologies locales en utilisant les matériaux locaux. Chaque pays comporte au moins un laboratoire d'énergétique qui s'occupe des énergies renouvelables. Ces énergies permettent de lutter contre les gaz à effet de serre.

Keywords: technologie de séchage solaire, equipe de recherche, laboratoire, Afrique centrale

Treatment of Piggery Wastewater using an Acti-zyme (Bio-catalyst) and Papermill Biochar Compound Co-capturing Biogas

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The world is facing formidable challenges in meeting rising demands of clean water as the available supplies of freshwater are depleting due to extended droughts, population growth, more stringent health based regulations and competing demands from a variety of users. At the same time, wastewater treatment plants are using energy from the national grid rather than generating their own energy. Piggery farms and paper mills use a lot of water and thus contribute towards water shortage. The piggery farms produce a significant amount of wastewater which can be effectively treated via anaerobic routes to harness biogas. On the other hand, paper mills are generating an excessive amount of sludge during paper making process. Secondary treatment of wastewater can therefore be used to make sludge based activated biochar which can be used in wastewater treatment. This work assessed the feasibility of using activated carbon from paper mill sludge (PMS) and *Acti-zyme* (a digestion bio-catalyst) to treat piggery wastewater anaerobically and co-capturing the biogas produced for energy usage. A piggery wastewater treatment plant generating 6000 m^3/day of wastewater was considered and the change in the wastewater physicochemical properties was determined using standard methods. The amount of biogas produced was determined using the water displacement methodology for retention periods of 30 days at 37 °C. The use of *Acti-zyme* and PMS biochar compound at 50 g/m^3 reduced the piggery wastewater contaminants properties such as ammonia, nitrates, phosphorous, turbidity and BOD_5 by >70%. The treated effluent met the set standards for effluent water disposal. Biogas was produced at a rate of 2.3 m^3/m^3.day with a bio-methane composition of about 78%. An industrial treatment process was designed to show the effectiveness in piggery effluent treatment co-capturing biogas. An economic assessment carried out on the process indicated a payback period of 3.5 years and rate on investment of 17%, this indicated the viability of adopting this technology for piggery wastewater treatment plants.

Keywords: Acti-zyme; biogas, economic viability, piggery wastewater

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SCIENCE SLAM: "Analogy between a Biogas and Human beings"

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In an effort to bridge the wide gap between the scientists and the society, science slam is the way forward; breaking down complex scientific phenomena into simple comprehendable phenomena and presented with ease in an entertaining way without distorting the concept.
Biogas plants have been in operation for decades, however, with the exception of scientists, majority of the ordinary beneficiaries of such plants cannot explain their operation, though they own them and operate them on a daily basis in their backyards. In this piece of work, an anology between a biogas plant and human beings is drawn in an endeavour to break down the complixity of biogas plant to a simpler and understandable system that even the layman can comprehend with every part of the biogas plant being related to a specific part of the human being body and its function. Conclusively describing every human being as a biogas plant.

Keywords: Science Slam, Biogas Plant, Human Beings

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An Assessment of the Potential of Solar Photovoltaic (PV) and Hybrid Renewable Energy Application in South Africa

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The world benefits greatly from fossil fuel resources with more than 80% of world's energy demand coming from fossil fuels. Proven coal reserves are sufficient for the next 113 years, while natural gas reserve is estimated to last up to 55 years. However, given the finite life of these resources and the need to reduce emissions alternative energy resources such as solar, biomass, hydro and wind are suggested as they are clean, abundant and effectively infinite. Solar PV is best known as a method for generating electric power by using solar cells to convert energy from the sun into a flow of electrons. In practice, it can be used in several variants depending on the demand and technical development of the user communities; grid connected, off-grid and hybrid energy systems are in use worldwide.

This study aimed at investigating and establishing the potential of solar PV energy for both off-grid and grid connected application across South Africa and to explore the viability and suitability of a hybrid renewable energy system (PV plus wind turbines) in coastal areas of South Africa. An *Optioneering* approach was used to determine the potential of solar PV and the hybrid energy system. This is a structured evaluation of the options in support of decision-making. The options (in this case the provinces) were modelled in 3 scenarios with different weights assigned to different key parameters. The parameters used in the modelling process were solar radiation intensity, electricity tariff, population, land availability, electricity consumption and electrification backlog. The Northern Cape Province has the highest solar PV potential for scenarios 1 and 2, followed by the Eastern Cape and Kwazulu Natal Provinces. Gauteng was found to have the highest solar PV potential for scenario 3. The parameters and their weighting are therefore significant in deciding the location where solar PV plant is to be established.

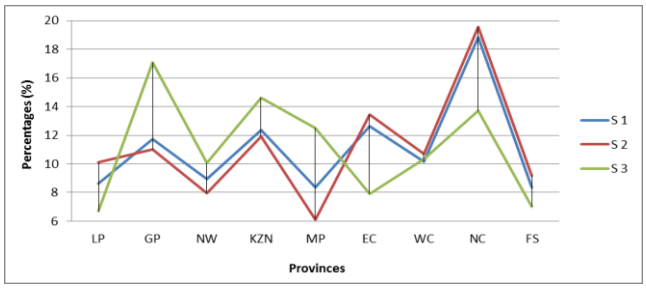


Figure 1: Variation of normalised technical potential for solar PV with province (LP, GP, etc.) in South Africa based on three different selection scenarios (s1-s3).

The PV module efficiency is critical in quantifying the potential power output over a certain period of time. The PV efficiency has shown a tendency of declining over time and it has been noted that PV degradation occurs at a faster rate than anticipated. This would have dire consequences for the solar PV investment in South Africa. The social dimension, variability and intermittency, regulatory framework, technical infrastructure and skills, training & capacity are the other main barriers for the development and growth of solar PV energy.

La Maîtrise d'Energie pour un Développement Durable de l'Afrique

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Abstract

Pour assurer un Développement socio économique Durable, les Pays Africains doivent adopter une politique énergétique volontariste et engagée basée sur l'utilisation rationnelle de l'énergie et l'exploitation des énergies renouvelables. En somme, la maîtrise d'énergie doit être le choix incontournable pour assurer une croissance en harmonie avec le développement durable. Pour se faire, l'Afrique doit prioriser la formation académique appliquée et la formation professionnelle qualifiante pour une grande maîtrise des technologies et des techniques en matière d'efficacité énergétique et des énergies renouvelables. Avec des potentiels énergétiques renouvelables et des compétences humaines locales, après que l'étude, l'expertise, la conception, l'installation, la maintenance soient maîtrisées, l'étape integration industrielle devient possible entrainant l'émergence de petites et moyennes entreprises au profit de la création d'emploi dans tous les secteurs et à tous les niveaux de qualification.

L'efficacité énergétique doit être considérée comme la première énergie renouvelable puisqu'elle génère, à elle seule, 70% du gisement d'économie d'énergie exploitable contre 30% pour les énergies renouvelables.

Le bâtiment et l'industrie sont des secteurs énergivores. Les pays africains sont en pleine croissance socio économique, par conséquent, ces secteurs vont connaitre un important développement durant les 2 prochaines décennies. La demande d'énergie va croitre d'une année à l'autre. Cette croissance doit se faire sans gaspillage ni perte, mais plus tôt dans le respect de la performance énergétique à tous les stades, depuis la production jusqu'à l'exploitation des sources d'énergie. Pour y arriver, les moyens technologiques sont aujourd'hui multiples et les résultats qui en découlent sont économiquement viables. L'expertise énergétique serait l'outil de base pour atteindre une efficacité énergétique certaine conduisant à une décroissance de l'intensité énergétique qui représente l'indice de performance en consummation d'énergie d'un pays.

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Study of Solar Tracking Step Size Optimization for Heliostats in a Central Receiver Solar Power Plant

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In a central receiver solar power plant (CRSPP), heliostats are arranged with respect to the central receiver so as to reflect the rays from the sun onto the power tower with high precision. The power output of CRSPP increases with the use of effective and efficient solar tracking techniques. However, current tracking techniques usually do not consider the weather conditions, nonlinear variation of sun position during the day and seasons, and energy consumption of the tracking mechanism. The purpose of the present article is to present a novel approach for heliostat tracking system based on dynamic optimization of tracking step size. Determining the optimum tracking step size of each heliostat is based on maximizing the energy gain from the sun and minimizing the energy consumption of the drive system. Dynamic models that simulate the mechanical and control components of the heliostat are presented and implemented using 3D CAD Solid Work and Labview software. These models involve mechanical and control design variables such as the motor parameters, power screw, heliostat mass, load forces, and wind forces. The energy gain of each heliostat is determined by using a Solar Algorithm for Sun Position (SAP) and a mathematical model for calculation of direct solar radiation. The energy consumption of drive system is calculated by computing the torque exerted on the drive motors using the CAD model and the drawn current using the Labview model. The present methodology is employed for optimization of tracking step size of a single facet small size heliostat with mirror area of 3 m^2. Simulations for controlling tracking step in real time for elevation and azimuthal angles of the heliostat are conducted during winter and summer days in Cairo with respect to different distances from the central tower. It is shown that the mechanical and electrical parameters of the heliostat and the drive system influence the tracking step size. Dissimilar distances from the receiver to the heliostat show interesting results.

Power System Protection

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As the penetration of wind power increases significantly, many challenges for such power plant arise. The most challenging part is to ensure the protection of the power network.
The aim of this paper is to design an automatic under frequency load shedding scheme which can be able to safeguard the power system against major disturbance involving multiple contingency events.
In the first part of the paper we deal with the methodology adopted for the design of the optimal number of load shedding steps and the amount of load to be shed in each step. Next, we test the performance of the developed load shedding scheme through dynamic simulations of the frequency response after a major disturbance.
The simulations were performed on a dynamic model of the power system using the software package SICRE.

Keywords: shedding; defense; frequency; safeguard

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Sustainable Energy Entrepreneurship Development in Africa
Case Study: FERDEDSI & IPEED process

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FERDEDSI is an output of a research and actions on energy entrepreneurship and the promotion of renewable energies as a strategy of fighting against poverty in sub-Saharan African rural areas. My presentation will show the steps from the research to implementations and social changes that follow. The aim of the paper is to stimulate partnership with academics and enterprises. During the first ANSOLE international meeting in February 2012 in Cameroon, with our team, we presented this energy initiative for local economic development. Since then our path, as described by the author presentation, is progressively merging to the organisational development path and vice versa. Such an unstoppable dynamism need to be connected to academics for interdisciplinary debate necessary for new paradigm of African development. ANSOLE platform is an adequate place as we were present at the first conference. For the 5th anniversary, our current presentation may bring opportunities for field practice and business development to the member of the platform, as well as opportunities for ANSOLE francophone branches.

Keywords: vulgarisation of RE, Socio economic in RE field, Incubation of RE enterprises

Topic 2
Energy Conversion
&
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38

Natural Smart House

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In this presentation, a new proposed project is introduced by R&D Department of ALWATANIA Company for technology. We expected that the Natural Smart House (NSH) will be the most famous projects at the future time. In this project, we discuss the new features of the design, implementation and specefications of the well-known Smart House (SH). The nature-inspired optimization algorithm is one of the most famous algorithms used in the field of computational intelligence of several systems. Natural Intelligence (NI) is based on several tecgniques which inspired by natural sciences (e.g. Neuroscience, Physics, Chemistry, Biology, etc.). These clever algorithms could smartly control of the quality of life's aspects within SH (e.g. Input Solar Energy, Household appartus' Communicatios, Lightening, Heating, Time Management, etc.). Such optimization algorithms could also improve the efficiency of the control systems within the SH. In instance, for the solar energy system, smart array controllers are modified in design and implementation using these advanced intelligence algorithms to have more efficiency of the overall control system of NSH. For another example, Near Field Communication (NFC) is an appropriate smart technology to control the communication links between household apparatus and mobile phones and also to make life easier and improve usability of different aspects of life.

Keywords: Clever Algorithms, Smart Controllers, Home Automation Systems Integration, Near Field Communication (NFC)

39

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Eco-Friendly Synthesis of Graphene Nano-sheets

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Graphene, one atom thick planer sheet of Sp^2 covalently bonded carbon atoms & densely packed in a honeycomb crystal lattice,[1] has gained much attention due to its remarkable physical properties, for instance, high electrical conductivity, flexibility, and good mechanical and thermal stability. Graphene has emerged as a new-generation organic electronic devices[2] such as touch screens and flat panel displays. However, the cost-effective and scalable production of graphene sheets still holds the challenge.[3] Accordingly, this work aims to fabricate high quality graphene nano-sheets in large scale, low cost from graphite and graphite oxide using different new eco-friendly methods, i.e. liquid phase exfoliation of graphite. The obtained results, including XRD, UV, TEM, SEM and IR confirmed the successful exfoliation of graphite layers into graphene nano-sheets upon using the devolped approaches.

Keywords: Liquid Phase dispersion of Graphene, Graphene, Graphene Oxide, Graphite.

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40

Potential of Household Waste and its Valorization in Cameroun

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Abstract

This research work aims at seeking ways and means to improve and valorize the biomass potential collected in the town of Yaoundé in Cameroon. The company in charge of the collection and management of waste in Cameroon is HYSACAM (Hygiene and Healthiness of Cameroun). A study carried out in its waste discharge centre located at Nkolfoulou made it possible to note that the rate of waste collection in the town in 24 years is only 40% and the remainder of 60% uncollected remains a serious threat for the environment. These 60% of waste not collected represent in quantified terms more than 7 million tons of waste. In this quantity exists a good portion of waste coming from pigs defections which one finds in several families in certain quarters like Nkolmessing, Nkoabang and Mbiyem Assi. In order to valorize this potential and fight against the global warming, a study enabled us to observe that the construction of bio-digesters (figure 1) of a capacity of $6m^3$ (6 to 8 people on average per family) for the production of biogas and electricity would be a suitable solution to this problem. Besides, this would bring a solution to the gas shortage and even electrical energy in several households of the city.

Keywords: Biomass; Bio-digester; Biogaz; Electricity



Figure 1: Construction of Bio-digester

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Characterization of FeMnCuO4 Paint on Textured Aluminum Substrate for Solar Thermal Application

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$FeMnCuO_4$-paint has received much attention as one of the solar absorber paint coatings due to its low cost and ease to coat on various substrates. It has been tested suitable in household solar thermal water heating applications. Improving its solar spectral selectivity as a means of boosting absorber efficiency, calls for efforts to increase its absorptance, α, and choice of low infrared (IR) transmitting binders to lower the thermal emmittance, ε.

$FeMnCuO_4$-paint prepared from solution of manganese acetate, iron chloride and copper chloride was dip-coated in the IR transmitting titanium dioxide, TiO_2, binder on textured aluminum (Al) substrates. The texturing of the aluminum substrates ensures the right surface topography, pore size and shape with regard to the incoming solar wavelengths. Optical characterization of the absorber coating with respect to reflectance, *R*, and absorptance, α, has been carried out and the film's thermal emmittance, ε, as a function of operating temperatures determined. The microstructure, morphology and controlled texture of aluminum substrates were analyzed using scanning electron microscope (SEM) and X-ray diffraction (XRD). The crystallographic planes with prominent peaks appearing at 38, 44, 65 and78 degrees which corresponds the (1, 1, 1), (2, 0, 0), (2, 2, 0) and (3, 1, 1) planes were noticed.

Controlled texturing of substrates ensured enhanced light trapping which increases absorption, α, and the use of infrared transmitting TiO_2 binder for the $FeMnCuO_4$ reduces thermal emmittance, ε. With the increase of α and reduction of ε, the efficiency of thermal conversion of the collector increases.

Keywords: Aluminum; Texturing; Reflectance; Solar energy

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Enhanced Biomethane production from Industrial Waste Stream Using Anaerobic Biofilm Bioreactors

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Depleted energy resources, increasing worldwide energy demand, and global climate change, mainly caused by anthropogenic activities of fossil fuels can be detrimental to economic development, particularly in areas of high-energy consumption. Anaerobic digestion is the preferred treatment process for organic wastes due to its low nutrient requirements, low biomass yield, and biogas (CH4) production.[1] Anaerobic digestion processes have been widely applied to various complex feedstocks including municipal wastewater sludge, chemical, and agricultural industry wastewaters. However, current conventional anaerobic digestion processes require a hydraulic retention time (HRT) of up to 40 days to achieve the necessary stabilization of organic wastes, which translates to a large footprint.[2]

An alternative approach is to design and develop a sustainable anaerobic biofilm digestion system that is not only capable of integrating functions i.e. biodegradation, biomass-liquid separation, and biomass retention at high suspended solids content while reducing energy demand but also can be easily applied to retrofit existing conventional technologies. [3] The AnaBiofilm offers numerous advantages over conventional systems including low footprint, decoupling of hydraulic retention time (HRT) from solids retention time (SRT), and high biomass-liquid separation. The proposed technology achieved a sustainable replacement and retrofitting option and develops an economical, robust and efficient process to enhance the production of bioenergy in the form of biomethane during the treatment of high strength organic industrial streams with up to 25% enhancement in biomethane production and organic removal.

Keywords: Biomethane production, Biofilm Process, Waste-to-Energy, Industrial Waste Stream

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Prototype Systems for Rechargeable Magnesium Batteries

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Despite their great commercial success, lithium-based batteries have some drawbacks associated with safety issues, high cost, and resource scarcity. Investigations on solid state rechargeable magnesium batteries are considered important similar to lithium batteries. In view of negligible hazards and less reactivity of the magnesium, in comparison with lithium, studies on rechargeable magnesium batteries are expected to have a wide scope in future. Although all these attributes of the magnesium battery there are several challenges like the growth of passivating surface films at the surface of electrodes and the difficulty of intercalating Mg ions in many hosts postpone using magnesium battery at the commercial scale. Upon the above consideration, we have now developed rechargeable Mg battery systems that show promise for applications. The systems comprise gel polymer electrolyte solutions based on $MgBr_2$ salts, and GeO_2 cathodes, into which Mg ions can be intercalated reversibly, and with relatively fast kinetics.

Keywords: Magnesium battery; Germanium oxide; Graphene; gel polymer electrolyte

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44

MnO_2 Nanoflowers from Spent Batteries to Supercapacitors Application: Waste to Wealth

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The electrochemical performance of MnO_2 nanoflowers recovered from spent Zn–C battery was studied by cyclic voltametry, galvanostatic charge-discharge and impedance spectroscopy. For comparison, MnO_2 has been prepared by electrodeposition (galvanostatic and potentiostatic) of $KMnO_4$. In an effort to utilize recovered MnO_2 nanoflowers as energy storage supercapacitor, it is crucial to understand their structure and electrochemical performance. MnO_2 deposited by galvanostatic condition showed smaller particle size, less compact layered structure, wider band gap and higher specific capacitance in comparison to potentiostatic deposition. Charge–discharge results showed that the MnO_2 possess good capacitive behaviour (207, 195 and 188 F g^{-1}, respectively at 0.5 A g^{-1}, for galvanostatic and recycled and potentiostatic MnO_2, respectively) with stable cycling up to 900 charge-discharge cycles. In addition, impedance analysis suggests that the MnO_2 could be a potential candidate for fast charge–discharge supercapacitor with low charge transfer resistance and low time constant. The prepared MnO_2 materials have been widely used in supercapacitor application and our findings show that MnO_2 recovered from batteries and obtained by galvanostatic are more suitable to be applied as supercapacitor electrode, due to the higher specific capacitance, lower resistance and higher electroactive surface area.

45

Keywords: Nanoflowers, Battery Recyling, electrodeposition, Supercapacitance, Cyclic Voltammetry.

Comparative Simulation of Molten Salt and Synthetic Oil Parabolic Trough CSP Technology in Sokoto, Northern Nigeria

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In this study a comparative analysis of the energetic and economic assessments of molten salt (MS) and synthetic oil (Oil) Parabolic Trough Concentrating Solar Power plants was undertaken for Sokoto in Northern Nigeria. The simulation was done using the National Renewable Energy Laboratory's (NREL's) Solar Advisor Model (SAM). The study site was selected based on the site Direct Normal Irradiation (DNI) value and hours of sunshine per day which are comparable to that of the sites where Concentrated Solar Power (CSP) plants are operating in Southern Spain. The results show that Molten Salt plant is more favoured to be adopted for use in the study site because it has higher annual electrical energy generation, higher capacity factor and lower Levelised cost of electricity. The Net Present Value of the CSP plants at the study site is positive implying that the project is economically viable. Also the levelised cost of electricity (LCOE) of the two CSP plants at the study site is lower than the feed – in Tariffs' (FIT) for solar energy generation in Nigeria for 2013 (0.425). This implies that over the life time of the projects, the project will break even.[1-4]

Keywords: Concentrated Solarb Power Plant, Direct Normal Irradiation, Heat Transfer Fluid

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Design of Small Mobile RO Water Desalination Plants Powered by Renewable Energy to be deployed at the Egyptian Desert

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Water desalination projects based on reverse osmosis technology are being introduced in Egypt to combat drinking water shortage in remote areas. Reverse osmosis (RO) desalination is a pressure driven process. The present work represents the results of two case studies of the design for integrated brackish water and seawater RO desalination plants with renewable energy. Two small Mobile PV driven RO desalination plant prototype were designed and field-tested. Renewable energy-driven reverse osmosis desalination can potentially break the dependence of conventional desalination on fossil fuels, reduce operational costs, and improve environmental sustainability. Moreover, the innovative features incorporated in the newly designed prototypes are focusing on improving the cost effectiveness of producing drinkable water in remote areas. This is achieved by maximizing energy yield through an integrated automatic single axis PV tracking system with programmed tilting angle adjustment. Autonomous cleaning system for PV modules is adopted for maximizing energy generation efficiency. RO plant components are selected so as to produce 11-20 m^3/day of potable water. Mobility of the system will provide potable water to isolated villages and population as well as ability to provide good drinking water to different number of people from any source that is not drinkable.

Keywords: Design, Reverse osmosis, Renewable Energy, Desalination, Egypt



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A new Algorithm for Discrimination between Internal Fault and inrush Currents in Power Autotransformers

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The autotransformer is an important component in any extra high voltage-high power system; hence, adequate and reliable protection is essential to ensure power flow continuity. The conventional differential protection schemes fail to protect the autotransformer in some conditions, such as, current transformers mismatch and saturation, and during inrush conditions. In this work, a new algorithm is derived to provide reliable protection for the autotransformer to discriminate between internal fault and inrush currents based on the current waveforms' frequencies and RMS values. The algorithm was tested using several simulation cases and proved to be effective and fast in discrimination. In addition, the algorithm is simple enough to be practically implemented.

Keywords: Autotransformer, inrush current, internal faults

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48

A New Approach to Investigate CO2 Storage: Experimental Study of the Interaction between CO2–Water–Rock in Reservoir System

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Geological sequestration of CO_2 is the most promising strategy in terms of capacity to reduce emissions of greenhouse gases. Carbon dioxide will be sequestered for geological periods of time, then it depend on the performance of the cap rock to prevent the CO2. The interactions between CO2 and rock are widely unexplored. a view to characterize potential CO2–water– rock interactions, through a laboratory experiment, various samples have been experimentally reacted in low-salinity water with supercritical CO2 in situ reservoir conditions (P = 90 bar and T = 60 °C) for 15 days. The characterization, obtained prior to and following reaction, and the changes in the mineralogy of selected various samples were investigated by X-ray diffraction, Fourier transform infrared spectroscopy , field emission scanning electron microscopy and photoluminescence. Experimental results show that mineral trapping is considered as a fairly long process, owing to the existence of kinetic barriers for mineral precipitation. This work will be useful for studies of partitioning mechanisms for trapping in CO2 storage programs.

Keywords*:* Carbon dioxide-cap rock-X-ray diffraction–scanning electron microscopy–photoluminescence.

Bio-Energy resources (Water Hyacinth) of Vembanadu Wetlands (S. India)

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The Vembanad wetland (2,033 sq km) is the largest wetland system in India. Around 1,100 sq km of it is located below the mean sea level. This lake has been infested with invasive water hyacinth (Eichornia crassipes). The water hyacinth is giving a tough time to tourism industry and fishermen. Water hyacinth cannot be eradicated completely from these wetlands. Its fast growth rate coupled with the excessive fertilizers released into the water bodies leading to eutrophication are the major hindrances to the strategies for eradication of water hyacinth. Harvesting them for industrial use serves as a means of environmental pollution control. The plant has abundant nitrogen content and it can be used a substrate for biogas production. Siddha doctors consider it as an excellent source of biogas. The hydrocarbon in hyacinths is higher than in cow dung and vast quantities of the plant are available. The manufacturing process is simple and plant is used to produce biogas with minimal pollution. The initial trials in have shown that 1kg of plant can produce 10kg of methane. Large-scale use of hyacinth as a fuel source may not be viable due to transport costs involved. The plant is extremely tolerant of and has a high capacity for the uptake of heavy metals, including Cd, Cr, Co, Ni, Pb and Hg, which could make it suitable for the bio-cleaning of industrial wastewater.

Keywords: biogas, Renewable energy, biocleaning

50

Analysis of a Sustainable System for Producing Motive Power and Refrigerating

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This paper presents a theoretical study of a sustainable system, which combines the ORC cycle and the ejector refrigeration cycle. This combined cycle produces power and refrigeration simultaneously. The system could use low temperature heat sources as renewable energy (solar and geothermal energy). A simulation was carried out to evaluate the system performance using several refrigerants. The ejector is studied in optimal operating regime. The influence of thermodynamic parameters on system performance is studied. The results show that the condenser temperature, the evaporation temperature, the extraction ratio, the refrigerant and the generating temperature have significant effects on the system performances.

Keywords: COP, ejector, modeling, refrigerant, simulation, solar energy, turbine.

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An Integrated Design Approach of Local Control System of a Linear Drive Single Facet Heliostat

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In a central receiver solar power plant, heliostats are arranged with respect to the central receiver so as to reflect the rays from the sun onto the power tower with high precision by tracking the sun in both the azimuth and elevation directions. The master control system of a solar power plant consists of different levels. The first level is local control; it takes care of the positioning of the heliostats when the aiming point and the time are given to the system, and informs upper level about the status of the heliostats field. The second logic level makes some important dispatch calculations of heliostats field. The most popular linear two-axis local driving system of heliostat consists of two linear driving actuators, the driving mechanism with rotary joints, and the controller. Traditional methods for heliostat design are often based on a sequential approach in which the mechanical structure is designed first and then the control system is advised. In order to reach the optimal design of heliostats, an integrated design approach that concurrently considers the interactions between the mechanical and control subsystems is necessary. In this article, an integrated design methodology of heliostat drive system is presented. The methodology is based on modeling and simulation. The dynamic models that describe the behavior of the mechanical and control components are presented. These models involve mechanical and control design variables such as the motor parameters, power screw (including back lash), heliostat mass, load forces, and wind forces. Matlab, SimMechanics, Solidwork, and Simulink are chosen to apply Artificial Neural and Fuzzy Inference System as supervisory control to heliostats, due to the ability to arbitrarily model complex mechanical systems, directly import properly constructed, third-party 3D CAD models, simulate integrated control, handle a variety of robotics nomenclature, and other features. The present methodology is employed for integrated design of a single facet small size heliostat with mirror area of 3 m^2.The methods described in this article also show a way to rapidly simulate novel and complex heliostat geometries. Analysis of the heliostat drive system performance and dynamic characteristics according to mechanical and control design variables is conducted for the purpose of control system design and performance optimization. The drive system performance is evaluated in terms of positioning contour errors, system stability, and system response. It is shown that the mechanical characteristics of the ball power screw actuator such as ball-screw diameter, lead, overall flexibility, stiffness, natural frequency and inertia significantly influence the performance of drive system.

Keywords: Integrated design, heliostat tracking, single facet heliostat

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52

Online Self-Calibration Active Feedback Control System for Heliostats in a Solar Power Plant

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In a central receiver solar power plant, heliostats are arranged with respect to the central receiver so as to reflect the rays from the sun onto the power tower with high precision by tracking the sun in both the azimuth and elevation directions. The master control system of a solar power plant consists of different levels. The first level is local control; it takes care of the positioning of the heliostats when the aiming point and the time are given to the system, and informs upper level about the status of the heliostats field. The second logic level makes some important dispatch calculations of heliostats field. The most popular linear two-axis local driving system of heliostat consists of two linear driving actuators, the driving mechanism with rotary joints, and the controller. Traditional methods for heliostat design are often based on a sequential approach in which the mechanical structure is designed first and then the control system is advised. In order to reach the optimal design of heliostats, an integrated design approach that concurrently considers the interactions between the mechanical and control subsystems is necessary. In this article, an integrated design methodology of heliostat drive system is presented. The methodology is based on modeling and simulation. The dynamic models that describe the behavior of the mechanical and control components are presented. These models involve mechanical and control design variables such as the motor parameters, power screw (including back lash), heliostat mass, load forces, and wind forces. Matlab, SimMechanics, Solidwork, and Simulink are chosen to apply Artificial Neural and Fuzzy Inference System as supervisory control to heliostats, due to the ability to arbitrarily model complex mechanical systems, directly import properly constructed, third-party 3D CAD models, simulate integrated control, handle a variety of robotics nomenclature, and other features. The present methodology is employed for integrated design of a single facet small size heliostat with mirror area of 3 m^2.The methods described in this article also show a way to rapidly simulate novel and complex heliostat geometries. Analysis of the heliostat drive system performance and dynamic characteristics according to mechanical and control design variables is conducted for the purpose of control system design and performance optimization. The drive system performance is evaluated in terms of positioning contour errors, system stability, and system response. It is shown that the mechanical characteristics of the ball power screw actuator such as ball-screw diameter, lead, overall flexibility, stiffness, natural frequency and inertia significantly influence the performance of drive system.

Keywords: Heliostat calibration, Integrated design, heliostat tracking, single facet heliostat

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Modeling and Simulation of Turbulent Reactive Flows in a Flue Gases Cylindrical Incinerator: Effect of Geometrical Parameters

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This paper discusses a simulation and modeling of turbulent reactive flows in a flue gases cylindrical incinerator. The effects of geometrical parameters on the chemically reacting turbulent flow and thermal fields in the incinerator are investigated. The turbulent flow was modeled with a standard $k-\varepsilon$ two-equation turbulence model. The chemical reaction was flue gases combustion. The chemistry-turbulence interaction was simulated with an eddy-dissipation model. Results are presented as streamlines, isotherms, isoconcentrations for different relative height opening, aspect ratio, and relative position of openings. The cleaning up of the smokes is better with an outlet port position shifted with respect to the inlet port location.

Keywords: Simulation, turbulence, Eddy-dissipation, k-ε model, flue gases.

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54

The Influence of Hydraulic Retention Time and Oxic/Anoxic Ratio on the Nutrient Removal from Municipal Wastewater in Sequencing Batch Reactor

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The influence of hydraulic retention time (HRT) on the effectiveness of nutrient removal from municipal wastewater in a sequencing batch reactor (SBR) was investigated. The pilot scale with operating volume 5 m3 is operated with hydraulic retention times of 8, 12 and 24 hr. The removal of COD and nutrients is investigated for the different cycles. Although the 24-hrscycle time has good effluent quality, however, the 8-hrs cycle time could be taken as the best cycle time, as cost, time and effluent quality are taken into considered in the treatment process.

Keywords: Sequencing Batch Reactor (SBR), retention time

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Wind Turbine near Wake Instigation

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Lately, the generation of energy from wind became one of the most promising renewable energy techniques. The main obstacle in today's growth of wind turbines is to build big rotors and to increase the efficiency of these big turbines to catch more power out of the wind. In this study, an experimental study is carried out to describe the figuration and the upgrowth of the helical tip vortices and turbulent flow structures in the near wake of horizontal axis wind turbine model placed in a wind tunnel. A dantec dynamics particle image velocimetry system (PIV) is being used to get detailed flow field measurements to quantify the time upgrowth of the helical tip vortices in relation to the position of the rotating blades of turbine. This study will be useful to unfold the implied physics affiliated with turbine power generation and fatigue loads affecting on the wind turbines.

Keywords: Turbine wake aerodynamics - HAWT- PIV measurements

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Synthesis of a New Hybrid Based Polyphosphazine Backbone for Direct Methanol Fuel Cell Applications

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New structures of Sulfonated organic inorganic material with a polyphosphazene backbone were synthesized to investigate the effects of this new structure on the membrane properties in the direct methanol fuel cell application. The new structure was confirmed by H NMR analysis and FTIR. Furthermore, nanocomposites polyphosphazene / graphene nanosheets were also synthesised. The series of membranes properties were invastigated. The mechanical properties are better than those of other type of polyphosphazene thanks to addition of sulfonated polyethylene ethylketone and the graphene nanosheets. The water uptake, methanol permeability and swelling ratio of the membranes have been also evaluated.

Keywords: direct methanol fuel cell, polyphasphazene, graphene nanosheet

57

Sliding Mode MPPT Control for Three -Phase Grid-Connected PV System with Fuzzy Logic DC Bus Regulation

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In this paper, we present a grid connected photovoltaic system using sliding mode control for maximum power point tracking (MPPT) in order to extract the maximum available power of the PV panels that can be injected to the system, while taking into account the change in the radiation and temperature. The regulation of DC bus voltage is of great importance because it is the main effect of the stability of the system. The voltage must be kept within certain limits to ensure control of the energy transfer between the PV generator networks for this reason we used fuzzy logic DC bus regulation strategy for grid connected PV. The simulation results show that the strategies of control applied on the system can track the maximum power point of PV panels quickly and effectively. Also it can realize the stability control of the DC bus voltage on the different perturbation of radiation and temperature.

Keywords: mppt, sliding mode control, fuzzy logic, PV

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Economic Analysis of Water Desalination Plants using DEAP Program

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Reverse Osmosis (RO) has proven to be the most reliable in producing fresh water compared to other desalination technologies. It is the fastest-growing desalination technology with a greater number of installations around the world. The economic and technical performance of a small-capacity RO desalination plant is (4-5 m^3/day) in the North West coast of Egypt (as a example).
This paper presents the thermal and membrane desalination economic analysis and outlines procedure to calculate the product unit cost for various desalination processes.
There are many kinds of desalination plants working all over the world and with the continued progress of the technology of desalination makes inter-State competition much more to discover desalination methods less expensive than previously or work to reduce the unit costs of desalinated water in order to alleviate the acute shortage of water all over the world.
This paper aims to clarify various economic transactions in the analytical program used to calculate the product unit cost of water desalination by different methods used and comparison between them. DEEP program is used to analyze osmosis desalination membranes and thermal data, The Desalination Economic Evaluation Program (DEEP) is a tool made freely available by the International Atomic Energy Agency, which can be used to evaluate performance and cost of various power and water co-generation configurations.

Keywords: water desalination; Reverse osmosis; Economic evaluation program.

A study into the Power System Impact of New Power Plant

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This article focuses on new power plant impact into the electrical system operating. It examines any constraints that may interfere with the smooth operation of the power system. The examination has been performed considering an example of power plant whose power generation highlights constraints on the network. An appropriate solution to reduce these constraints is also suggested. The simulations results have been obtained by load flow calculations. The work presented can be used as a guide to study any project relating to the implementation of a new power plant.

Keywords: impact analysis; implementation; power system operating; network.

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Configuration Consideration in Low Concentrating Photovoltaic Systems

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A solar concentrator is a device that is capable of concentrating solar energy over a relatively large area onto a smaller surface. Concentration is achieved by the use of suitable reflecting or refracting elements which increases the flux on the absorber surface as compared to the aperture surface. Although the apparent movement of the Sun is very familiar, its geometry is rather complicated and hence, concentrators should be designed to suite the two extreme cases namely: i) track the Sun such that the axis of the concentrator always points in the direction of the Sun (good for point focusing) and ii) have a fixed concentrator but its aperture has a large solid angle (good for line focusing). A tracking type concentrator may be mounted on a single axis or on a double axis to constantly follow the Sun. Optically; concentrators may be reflecting or refracting, imaging or non-imaging and line focusing or point focusing. The reflecting or refracting surface may be one piece or a composite surface. It may also be a single stage or double stage system and may be symmetric or asymmetric in design. Similarly, concentrators may be classified as low, medium and high concentrators depending on their geometrical concentration ratios.

However, in low concentrating photovoltaic systems fixed (stationary) concentrators are preferred with special reference to design parameters such as the acceptance angle, focal length, exit and entrance apertures of the concentrator. In this work, we present some experimentally tested and simulated configurations on performance outputs. For a symmetric compound parabolic concentrator (CPC) with a geometrical concentration ratio of 3.6, an acceptance half angle of 15^{o}, and the exit aperture of 10cm, an increase of about 2.5 of the short-circuit current was observed when diffuse reflector (rolled aluminium) material was used in the CPC [1].

Keywords: Low concentration, acceptance half angle, geometrical concentration ratio

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Performance of a Solar Cooker with Heat Storage in the Northern Part of Cameroon

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This work is the development of a solar cooker with heat storage using local materials. The equipment is welcome in the northern region of Cameroon because of its significant solar potential (600W/m²). A cooker with an area of 0.20 m² was carried out on the scientific basis of heat transfer. Collecting data of temperature and irradiance were also made in different position of reflectors. The system helped bake a cake in 1 hour 30 minutes including warm-up time of the enclosure. The air's temperature has reached 145.75 °C for an irradiance of 1100 W/m² in empty room. The storage, using the black volcanic stone has not only reduced temperature fluctuations during the day but to keep the temperature at the value of 60 °C for 5 hours in the absence of the sun.

Keywords: reflectors, solar cooker, northern region of Cameroon, temperature, irradiance

62

Energy Recovery of Waste Papers through the Production of White Coal

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This work focuses on energy recovery from waste paper for the production of domestic fuel (white charcoal). In the town of Maroua, waste paper is generated by printing house and institutions such as schools, administrative offices etc. These waste products in large quantities are not recycled and are usually burnt. The purpose of this study is to produce a fuel composed of waste paper and clay used as a binder. The proportion of 50%, 35%, 20% and 0% of clay were used in mixture with the waste paper collected to produce white charcoal. The best combustion results were obtained from a composition of 80% paper and 20% clay (CB80). The calorific value of CB80 was assessed to 13.15MJ / kg and moisture content to 7%. Cooking tests show that it takes an average of 0.633kg of white charcoal to cook 1 kg of rice in 32.6 minutes. The assessment of annual potential of white coal indicates that 6.398×10^3 tons can be produced at the Higher Institute of the Sahel and HYSACAM Landfill waste located at Yonkolé. It is enough to cook 10.234×10^3 tons of rice and to satisfy the annual rice consumption of 787230 persons in Cameroon. When converted into firewood, this potential of white charcoal could cover the annual energy needs for cooking of 17 117 people in the town of Maroua. The ecological benefit when using the above quantity of white charcoal for cooking is the annual protection of 1587 ha of land in the Sahel area from the destruction by the population collecting firewood. The economic study of an industrial production unit of white charcoal shows that the net present value after 10 years is 88 847 679FCFA. The payback period of the consequent investment estimated at 24 500 000F CFA is 5 years 5 months.

Keywords: Clay, Cooking, Energy, Waste Paper, White charcoal.

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Valorization of Wastes and Photovoltaic use in Chad

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In this communication, we show how sugar industry's wastes are valorized in producing biofuel namely Ethanol. These wastes are used in agricuculture and road managing.
We show the pertinence of photovoltaic production of electric energy and the use of PV devices in rural aeras of Chad.
Furthermore, we propose what we call Integrated Energy Production Systems. Many researchers in the field were concerned by the accumulation (Batteries,...) issue. A solution is to combine PV, Hydraulic (wind) and biomass systems avoiding thus the problems of energy storage.

Keywords: valorization of industries wastes, Integrated Energy Systems, biomass, photovoltaic.

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64

Solar Cavity Design for a Central Receiver System

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CSP4Africa is a project that aims to develop a central receiver plant system in 2iE in Burkina Faso. The plant, which must be adapted to mini grids, is supposed to have a solar field of 100 kWth and will be a basis to study the profitability of these kinds of plants, as solutions to provide electricity to the remote areas in Sub-Saharan Africa.
In order to reduce the investments expenses and therefore the decrease of the electricity cost, some of the components like the solar receiver, the tower and the heliostat field are supposed to be manufactured by local manpower with available materials in the local environment.
This paper deals with the design and manufacturing of the solar receiver of the project. According to the studies on solar receivers, the latter can be classified in three groups [1] : volumetric [2], tubular [3] and particle [4] receivers. The first ones are used for high temperatures CSP (>900°C) and did not demonstrated sustainability in various tests whereas the last ones still in the research phase. Most of the solar receivers used in the world are tubular and can be classified in two groups [3]: external [5] and cavity receivers [6]. For the CSP4Africa solar receiver, a cavity tubular receiver is decided and a cylindrical geometry is set as shape. The absorbing surface of the receiver is an helical coil, which represents the lateral part.
The modelling method used in this study is based on radiative exchange with the use of view factors. An energy balance is written on every coil, which is supposed to receive radiative energy from the incident flux, ambient atmosphere and the inner surfaces of the cavity, and at the same time, it emits radiation flux towards these inner surfaces and the atmosphere. An energy balance is also written in every volume of the heat transfer fluid of each coil. It is considered that the receiver operates in stationary mode. The optimisation process takes into account the operation temperatures as constraints. Optimisation variables considered were the number of the coils (height of the cavity), the inner diameter of the coil, the nature and mass flow of the heat transfer fluid. The exergy analysis leads to a cylindrical receiver with a height of 1 m and an aperture of 0.7 m; diameter of coils was set at 0.25 m. Thereafter, the component was manufactured by a local enterprise. Laboratory tests were conducted in a closed room (off-wind conditions) to determine the global convective heat losses coefficient, with is later used to extend the design model.
A non-stationary model, which integrates the variation of the solar irradiation, is derived from the previous stationary model. The simulation showed the trend of the temperature of the heat transfer fluid at the receiver's outlet according to incident flux.

Keywords: Solar receiver, receiver modelling, cavity receiver, helical coil, CSP4Africa

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Solar Concentrators Photovoltaic (CPV): Primary Optics Element

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Among the energy sources to develop in Morocco, priority is given to solar energy, for which many development projects are lunched. The technologies planned for these stations include both photovoltaic and concentrating photovoltaic (CPV).
The present work concerns the design of a specific Fresnel lens for CPV panels and it is a part of a large Moroccan projet dealing with the design and conception of Moroccan CPV low cost panel.
Many works have been developed for an optimal Fresnel lens design, but at each time with specific requirements. This study deals with the nonimaging Fresnel lens as primary optics element for collecting sunlight for solar concentrator's photovoltaic technology. The results of optical performances of the nonimaging primary optics element design for solar energy concentration will be evaluated by ray tracing and presented in term of flux distribution.

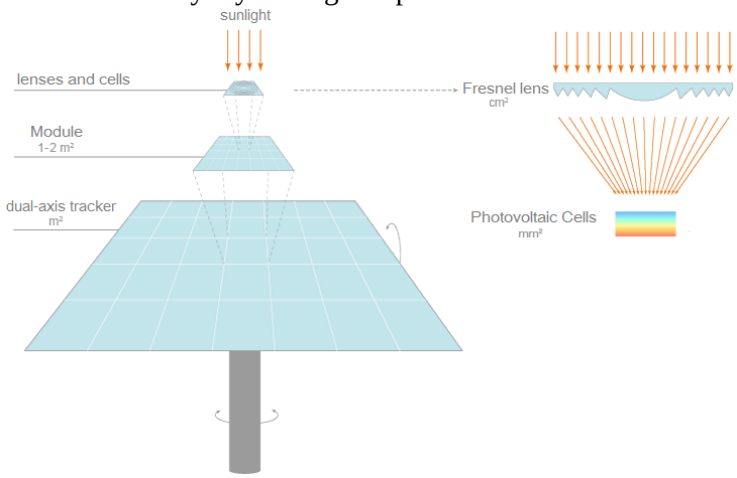


Figure1. Concentrator Photovoltaic based on Fresnel lens

Keywords: Non-imaging; Fresnel lens; primary optic; solar cells; Solar concentrator; Concentration photovoltaic system (CPV); ray tracing simulation.
Acknowledgments This research is supported by IRESEN l'Institut de Recherche en Energie Solaire et en Energies Nouvelles.

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Functional Nanoscale Materials for Water Splitting Catalysis and Solar to Chemical Energy Conversion

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Development of robust and high activity water oxidation electrocatalytic materials, and their synergistic interfacing with efficient light-harvesting modules is very important to progress the construction of solar to fuel conversion system, the "artificial leaf"[1]. Several molecular and Inorganic materials derived from first row transition metal oxides have displayed great potential to be employed as water oxidation electrocatalysts in model water splitting devices[1,2]. We recently have shown many examples of highly active and stable molecular as well as nanoscale materials for water oxidation catalysis under mild conditions [3,4]. Their effective interfacing with state-of-the-art semiconductor photo-responsive materials was also demonstrated [5]. A molecular layer of the homogeneous phase electrocatalyst on top of light harvester interfere very little with the underlying semiconductor. Our method and investigation thus show that catalyst-light harvester hybrid combination is an important development in the field of solar to chemical energy conversion, leading towards designing a tandem device for solar fuel generation.

Keywords: water splitting, solar fuel, semiconductor–catalyst heterojunction, light-harvesting

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Exergetic analysis and optimization regime of temperatures for absorption chiller single stage H_2O-NH_3

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Single stage absorption chillers using H_2O-NH_3 have received increasing research interest in recent years, in order to make them competitive with conventional refrigeration machines. This work presents a study on the performance of such tri-thermal machines, used for negative temperature refrigeration. The objective is to determine the values of the system operating temperatures that minimize the irreversible losses in the various heat exchangers. To do this,-the overall exergy efficiency of the system has been expressed as a function of the various operating temperatures. This objective function is to be maximized. The results show that the cycle is more thermodynamically efficient when the absorption cooling system is operated at a low evaporation temperature (lower than 0 °C). Thus, the exergy efficiency is maximal and varies from 0.46 to 0.52 for an evaporation temperature ranging from 0 to -15 °C, the heat source temperature from 75 °C to 120 °C and condensation/absorption temperature around 30 °C. At this states, the irreversibility losses are low and between 4.86 and 6.08 kW.
Keywords: absorption chiller, exergy, thermodynamic irreversibility, exergetic efficiency, water-ammonia.

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Review on Recent Advances in Microbial Fuel Cell Technology

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A microbial fuel cell (MFC) or biological fuel cell is a bio-electrochemical system that drives a current by using bacteria and mimicking bacterial interactions found in nature. The energy crisis makes the circumstances suitable for improvement of MFC energy production, which is a newer source of energy - cheaper, cleaner, and more sustainable. Efforts are being made to improve the performance of MFCs. This article presents a review on the recent advances in MFC technology.

Three-Dimensional Analysis of Quantum Tunneling Through Metal-Vacuum-Metal Junctions Using Transfer Matrix Method

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Quantum Tunneling and Field Emission from sharp tips have been always interesting topics to physicists for being the basic principles of many types of microscopes; such as Scanning Tunneling Microscope (STM) and Field Electron Microscope (FEM). Recently, more applications have emerged based on Field Emission; such as electronic displays, X-ray generation, high frequencies rectification and many other applications in the field of vacuum nanoelectronics. Thus, in order to go ahead in such applications, we are in imperative need for accurate theoretical modeling and characterization for practical systems subjected to these quantum mechanical effects. Field Electron Emission is the phenomenon of electrons tunneling from flat metallic surfaces into vacuum due to the effect of a strong externally applied electric field. This phenomenon was first explained by Fowler-Nordheim (FN) theory in 1928. Based on their explanation, Fowler and Nordheim could develop an expression for calculating the emitted current density as a function of the applied electric field. This expression lacked accuracy not only because of being based on the approximate JWKB method, but also due to neglecting the effect of the image potential induced by the tunneling electron (self-potential). Nevertheless, it agreed to the same order of magnitude with the experimental results.

When considering surfaces with sharp protrusions of radii in the range of a few nanometers, which is the typical range of the barrier widths, the surface flatness assumption is no longer valid, and the barrier should be treated as a multi-dimensional problem to account for the non-uniform field distribution and electron potential energy around the surface. For such problems it is necessary to solve Schrödinger equation with the non-uniform, structure-dependent potential energy, which is not an easy task. The benefit from following such a fundamental approach is that it can be generic and inclusive to all various types of electron emission collectively.

In this work, we illustrate a solution introduced by A. Mayer for the 3-D n-fold axially symmetric potential barrier problems using the Transfer Matrix method. In this technique, the wave functions are represented in terms of well-defined basis states in the uniform metal region. Next, the potential energy distribution for an electron inside the barrier is obtained. Any numerical method can be used for this purpose. Then, the barrier is divided into layers parallel to the uniform metal region. Assuming single state incident from the metal region, a propagating solution for Schrödinger equation is pursued in each layer with applying the boundary conditions obtained from the previous layer, till reaching the end of the barrier. This allows calculating the transmission coefficients for the states, and hence obtaining the tunneling current.
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Keywords: 3-D Quantum Tunneling, Field Emission, Metal-Vacuum-Metal Junctions, Nano-tip, Transfer Matrix Method

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Topic3
Photovoltaic Materials, Devices and Application

Photoelectrochemical Studies on Azole-Based Dye Materials Toward DSSC Applications

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Synthetic science is a major focal point for obtaining the next generation of organic and inorganic molecular materials. For research fields utilizing organic / inorganic materials as in solar energy capture materials, significant improvement in desirable properties of the materials depend on synthetic manipulations or tuning of known materials as well as on design and preparation of novel materials.
Clean and sustainable energy has been in the front burner for researchers in the energy sector.

Dye Sensitized Solar Cell technology is under intense investigation due to its relative efficient conversion of Sunlight energy to electricity. The organic-based dyes for DSSCs are designed to have donor units at one end, acceptor functions at the opposite end and π-linkers between them. Rigidification of organic dyes in DSSCs has been recognized as a viable tactics in improving energy outputs of donor-π-acceptor organic dye architectures utilized in DSSCs and imidazole moiety has recently attracted attention as a potential alternative for the commonly used triphenylamine donor end a recent report claimed that imidazole fragment could be utilized in place of the common 'push' moieties. In this presentation, a series of azole based materials were synthesized, characterized and spectroscopically / electrochemically examined for substituent influence on desirable organic-electronic behaviours. Results show that the imidazole nitrogen heterocylces are not electronically good building block candidates for the role of electron-push fragments by themselves contrary to a number of recent reports.

Keywords: DSSCs, Structure-Property Correlation, Synthetic organic dyes

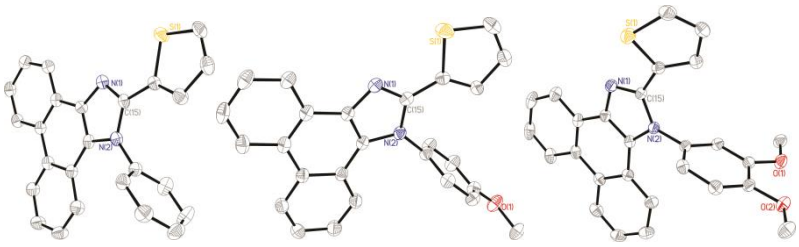
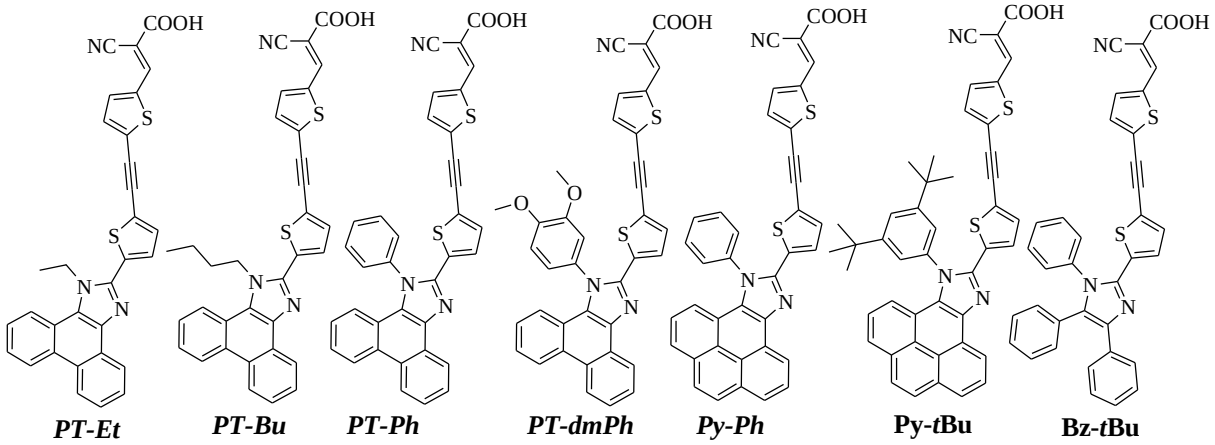


Fig. 1: Structures of the building units for the studied DSSC dyes



Scheme 1: Studied molecules

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73

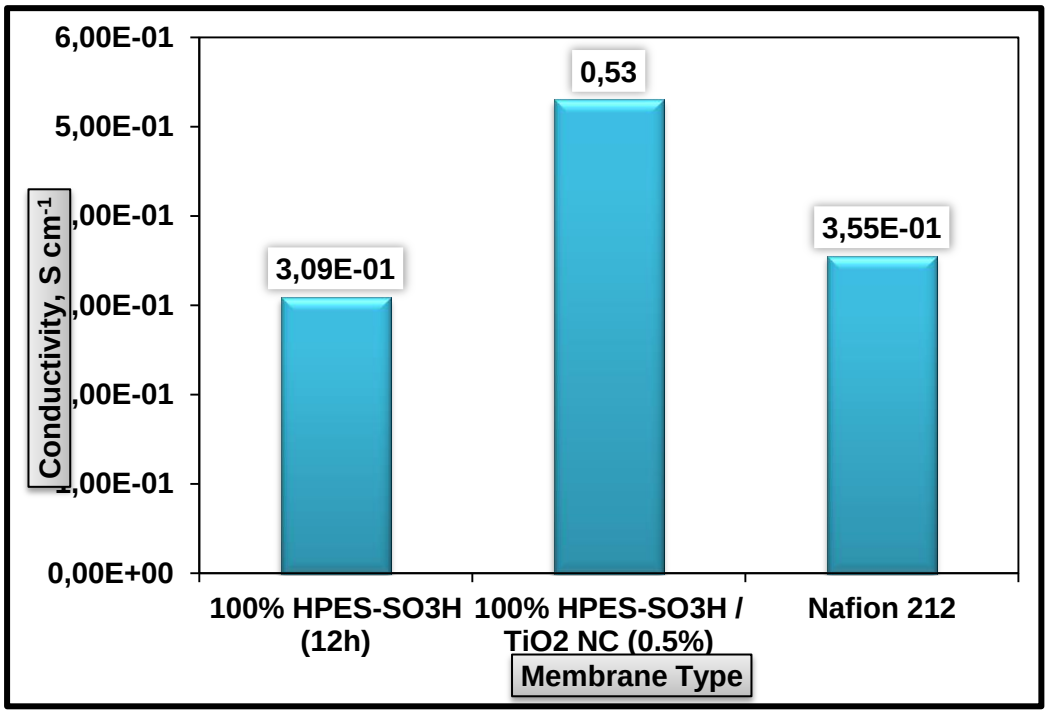
Novel Proton Exchange Membrane based on Hyperbranched Polyester/ TiO_2 Nanocomposites

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The proton exchange membrane, polymer electrolyte fuel cell (PEMFC) was first developed by general electric 1960's for first use by NASA in the space applications. The electrolyte is an ion conducting polymer separating anode and cathode. In 1967, Nafion (a florinated hydrophobic polymer) membrane, a trade mark by DuPont, became the available polymer membrane. Nevertheless, due to many drawbacks of Nafion such as high cost, low thermal stability and reduced water tolerance, many efforts are spent in order to develop a new polymer electrolyte PEM.

In this work, nanocomposites of hyperbranched polyester (HPES-OH) and TiO_2 nanowires (NWs) were synthesized. Films casted from blends of HPES-OH or its nanocomposites and polysulphone were prepared and their performance as proton exchange membranes was studied. Addition of different ratios of TiO_2 NWs to membrane blends was carried out to investigate the influence of the inorganic filler on the membrane water uptake and ionic conductivity.



Fabrication of Nanostructured Organo-Metal Halide Perovskite as Light Harvesting Active Layers for Low Cost Production of Solar Cells Energy

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Recently, perovskite $CH_3NH_3PbI_3$ sensitizers have attracted great attention due to their original electronic and optical characteristics. These materials demonstrated very high power conversion efficiencies in hybrid solar cells, initially based on the dye-sensitized solar cell (DSSC) concept. Usually, organometallic or organic molecules were mostly used as sensitizers for solid-state DSSC. Inorganic nanocrystals have lately received attention as light harvesters due to their high absorption coefficient and tunable properties, as well as metal chalcogenides. However, the best power conversion efficiency was reported to be around 7.2% using an organic hole transporter medium (HTM), and up to 8.5% using an inorganic HTM. $CH_3NH_3PbI_3$ (X = Cl, Br, or I) perovskite sensitizers made a breakthrough in solid-state mesoscopic solar cells, where the first record efficiency of around 10% was reported in 2012 using submicrometer-thick TiO_2 film sensitized with $CH_3NH_3PbI_3$. A rapid increase in efficiency was then observed over the last 3 years, leading to a certified record at 17.9%, further extended to over 19% more recently. In this context, the present research aims at fabrication and optimizing the processing of perovskite solar cells. Some element concerning device physics will also be considered.

75

Keywords: Solar cell, Perovskite, organic inorganic hybrid materials, Renewable Energy, ssDSSC

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Rectification Performance at Optical Frequencies using Geometrically Asymmetric Tunneling Junctions

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Metal nanostructures exhibit unique properties such as optical confinement and electric field enhancement. These properties can be explored in many applications such as the surface enhanced Raman spectroscopy and light harvesting. Several approaches have been proposed to model the optical response in the nanogaps between two metal nanoparticles. The simplest model is the classical local model which predicts an increase in the electric field enhancement as the gap size is reduced. Limitations for this model arise when the gap sizes are reduced to nanometer and subnanometer scales; where quantum tunneling between the metal nanoparticles leads to charge exchange, limiting field enhancement in the gap region between the two metals. To be able to capture these effects, one possibility is to perform rigorous quantum mechanical calculations of the optical response using Time Dependent Density Functional Theory (TDDFT). However, such full-quantum approaches are subject to a heavy computational load. Only relatively small structures have been addressed so far, typically for systems containing several hundreds of electrons.A new model, called the Quantum Corrected Model (QCM) was introduced to account for the tunneling current across the gap via the insertion of an effective conductive medium in the gap. A conventional solver of Maxwell's equations is then used to obtain the optical response for an arbitrary geometry. Results from this method are in very good agreement with experimental results and with the full quantum approach. In this study we examine the nonlinear tunneling conduction between gold electrodes separated by a subnanometer gap, producing a DC photocurrent when the gap is illuminated.

To address the QCM approach, we first need to model the potential barrier across the gap. For the case of spherical nanoparticles, since the size of the gap between the nanoparticles is much smaller than the radius of curvature, the local geometry of the junction can be approximated as two flat semi-infinite parallel metallic surfaces separated by a dielectric gap of size l. To calculate the conductivity of the junction, we have used the Drude model. Using the Wave Packet Propagation (WPP) approach, the tunneling probability was determined as function of energy and separation l, which was then used to find the static conductivity. The electric field enhancement was then plotted with the aid of a finite element solver.

Keywords: Quantum Corrected Model, Wave Packet Propagation, Time Dependent Density Functional Theory.

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Performance of P3OT:wt%CdSe hybrid photovoltaic cells

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Recently, there had been increasing interest in optoelectronic devices based on hybrid organic-inorganic materials [1, 2]. In this work, photoluminescence and photovoltaic properties of P3OT: wt%CdSe composite films are investigated as a function of CdSe nanoparticles (NPs) concentration (wt %) incorporated in the films. The incorporation of CdSe NPs produces a quenching of the photoluminescence and improves the performance of solar cells based on the composites. These effects are explained in terms of exciton dissociation and charge separation occurring at P3OT/CdSe interfaces within the Förster formalism, involving non-radiative energy transfer from the donor (P3OT) to the acceptor (NPs CdSe). An exciton quenching rate constant of 1.4.10-10 $cm^3.s^{-1}$ was determined using the Stern-Volmer equation. In addition, scanning electron microscopy (SEM) images revealed that the whole surface morphology was changed following CdSe NPs incorporation, in agreement with FTIR spectra. The J-V characteristics of ITO/P3OT:%CdSe/Al photovoltaic cells realized for the different CdSe concentration are also reported and indicate a significant improvement of the photovoltaic parameters cells, in particularly the conversion efficiency become 20 times greater than the cell based on pure polymer.

77

Keywords: Photovoltaic effect, fluorescence quenching, surface contact, exciton dissociation

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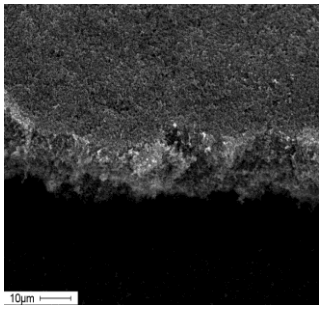
Zinc Oxide based Dye Sensitized Solar Cell using Eosin – Y as Photosensitizer

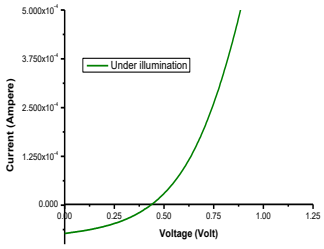
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A zinc oxide based Dye sensitized Solar Cell (DSSC) has been fabricated, using Eosin-Y as the dye adsorbed on a nanocrystalline zinc oxide - fluorine doped tin oxide electrode, for the sensitization of the large band gap semiconductor. The absorption spectrum of Eosin-Y showed high absorption of visible light between 450 and 600 nm wavelength. The SEM image of the annealed zinc oxide film revealed a uniform, porous and small round shaped grains. These are in favour of the solar energy conversion device. The short circuit photocurrent density (Jsc), the open circuit photovoltage (Voc) and the fill factor (FF) of the solar cell using Eosin-Y were obtained to be 7.243513 x 10^{-2} mA/cm^2, 4.325767 x 10^{+2} mV and 3.769144 x 10^{-1}. The efficiency of 1.2431 x 10^{-2} % was achieved due to a high series resistance of 4.2175 x 10^2 Ohms cm^{-2}.





Keywords: Eosin-Y, Dye Sensitized, Absorption spectrum, Photocurrent

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Optical and Electrical Properties of P-Substituted-Benzylidenemalononitrile Thin Films

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A donor-bridge-acceptor type conjugated molecule has been successfully synthesized and characterized. The optical properties such as absorption, photoluminescence and electrical properties such as cyclic-voltammetry and *J–V* characteristic of p-substituted-benzylidenemalononitrile (BMN) thin films have been investigated. The BMN films shows a wide absorption in visible region, which makes it possible for application in OPV and OLED. The band gap energy of BMN thin film was obtained by experimental calculation from cyclic voltammetry. From the current–voltage characteristics, the electrical bistability in such films can be associated with a memory phenomenon. The obtained results of the materials have promising to be applicable for various optoelectronic applications.

Keywords: Luminescence; Organic materials; Electrical bistability.

79

Study of the electrical and optical processes in organic photovoltaic devices

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Organic photovoltaics (OPVs) are an attractive worldwide research subject because they are cheap, thin, lightweight and flexible [1]. One of the most promising solar cells having a rapid progression of improvements are made from conjugated polymers and fullerenes in which a large hetero interface is achieved using so-called bulk-heterojunction (BHJ) morphologies. In order to design new materials for higher efficient devices, deep understanding of charge carriers diffusion processes in general is needed [2].

Investigations of capacitance at low-frequency of organic bulk heterojunction device made of an Anthracene-containing poly(p-arylene-ethynylene)-alt-poly(p-arylene-vinylene)/1-(3 methoxy carbonyl) propyl-1-phenyl[6,6] and C_{60} (AnE-PV*stat*:PCBM) blend, were made in detail at room temperature. Negative capacitance (NC) was observed in the dark under positive dc biases in the bipolar regime. The cole-cole impedance plots show clearly the presence of two semicircular arcs pointing to the origin, which provide direct evidence of NC. We model the impedance behavior using an equivalent circuit incorporating chemical capacitance (C_μ), recombination resistance (R_{rec}), transport resistance (R_t) and contact electrical resistance (R_{co}). The recombination time τ_{rec} decreases with increasing bias voltages. We also determined the diffusion time (τ_{diff}) and the diffusion length (L_n) and other parameters. Average electron mobility calculated for the device is around 4 10^{-3} $cm^2V^{-1}s^{-1}$. In order to correlate the optical properties of a conjugated polymer film with its morphology, we have employed the photoluminescence (PL) of an AnE-PVstat thin film, within a temperature range between 10 K and 300 K. The temperature dependence of the ratio of the 0-0 to 0-1 peak intensity reveals an H- aggregate type. We used a modified Franck Condon progression [3] with a variable 0-0 peak intensity to reproduce the experimental PL spectra. From the fit we have extracted the electronic transition energy E_0 and the disorder parameter σ.

Keywords: Negative capacitance, solar cell, diffusion length, H-aggregates, spectral diffusion.

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Influence of annealing temperature on proprieties of thin layer

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In this work we present the effect of temperature and duration of the treatment on the crystallization of thin layer. Porous silicon layers were elaborated by electrochemical etching of heavily doped p-type silicon substrates. Metallization of porous silicon was carried out by immersion of substrates in diluted aqueous solution of nickel. Amorphous silicon thin films were deposited by PECVD (Plasma enhanced chemical vapor deposition) on metalized porous layers. The samples have undergone heat treatment at different time and temperature. Structural and morphologic properties of crystallized silicon thin films were systematically analyzed by X-ray diffraction, Raman spectroscopy, Atomic Force Microscopy. Raman spectroscopy and X-ray diffraction results show that amorphous silicon thin films are fully crystallized.

Characterization of Connelina erecta leave based Dye – Sensitized Solar Cell

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Abstract

This study is aimed at investigating the performance of connelina erecta based dye –sensitized solar cell. Extraction of the dye from the connelina leave was done using distilled water and cold ethanol respectively. UV measurements were made for the ethanol extracted dye at pH of 7.56, 3.00 and 2.00 respectively. UV measurements were also made for distilled water extracted dye at pH of 3.69, 3.00 and 2.00 respectively. The Phytochemical screening for flavonoids and anthocyains was carried out on each extracted dye and it was found that both ethanol and distilled water extracted dye shows the presence of more flavonoid than anthocyanin in the leave. The results of the outdoor measurement for the cells of ethanol extracted dye give higher efficiency as compared to the cells of distilled water extracted dye.

Key words: Connelina eracta, Dye-sensitized, Flavonoid

Electrical Conductivity and Electrochemical Properties of Silver Nanoparticles/Zirconia Composite Thin films Fabricated Using Molecular Precursor Method

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Metallic Ag-nanoparticles zirconia (Ag/ZrO_2) composite thin films at different volumetric fraction of silver ($0.25 \leq \varphi_{Ag} \leq 0.67$) to titania were prepared on a quartz glass substrate at 600°C using the molecular precursor method, in order to find the percolation threshold for the electrical resistivity of Ag/TiO_2 composite thin films. Two precursor solutions for Ag-nanoparticles and zirconia were prepared from Ag salt and a zirconium complex, respectively. X-ray diffraction (XRD) patterns, field emission scanning electron microscope (FE-SEM) and UV/Vis absorption spectra were measured in order to study the Ag-nanoparticles in Ag/ZrO_2 composite films and to understand how the nanostructures influence the electrical resistivity of Ag/ZrO_2 composite thin film. It was found that Ag/ZrO_2 composite thin films consist of metallic Ag-nanoparticles homogeneously distributed in the tetragonal-zirconia (*t*-ZrO_2) matrix. The percolation threshold was identified and was at φ_{Ag} 0.44. The lowest electrical resistivity of 10^{-3} Ω cm at 25°C was recorded when the Ag fraction φ_{Ag} was at 0.54. It could be deduced that, Ag nanoparticles` shape, size and spacing distance among each other cause the changes in the electrical resistivity of the composite thin films. The photoelectrochemical property of the Ag/ZrO_2 composite thin films with the dispersed Ag-NP of φ_{Ag} 0.44 was examined. No photocurrent density for the composite thin film was recorded under UV-light irradiation as expected due to the band gap width of 5.78 eV for t-ZrO_2. The cathodic dark-current densities generated by the composite thin film could be however observed. The Ag concentration in the composites has a remarkable effect on the generation of dark current. Their excellent electrical conductivity and the major factors affecting the generation of dark-current density and current polarity are discussed, from the viewpoints of a new material being formed, on the basis of the new material having different electrical potential.

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Effect of Substrate Orientation on the Solar Efficiency and the Electrical Properties of Sulfonated Polyaniline (SPAN), Grown on (100) and (311)A GaAs

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Among the family of organic semiconductors, the semiconducting polymers such as Sulfonated polyaniline (SPAN) have attracted most attention for applications in electronic and optoelectronic devices, particularly due to their exceptional electrical properties and ease of preparation methods [1]. As a result, this category of polymers has been used in several applications such as organic light emitting diodes (OLEDs), solar cells, battery electrodes and photodiodes. SPAN, which represents a class of self-doped conjugated conducting polymer and a derivative of polyaniline (PANI), has received great interest in recent years, because of its unusual physical properties, improved processibility and potential industrial applications [2]. Additionally, this polymer can be grown over large area with low cost.

83

SPAN thin films have been efficaciously deposited by a very simple technique on n-type Gallium Arsenide (GaAs) substrates to fabricate heterojunction devices with excellent electrical properties. In this work two heterojunction devices of SPAN on n-type (100) GaAs and (311)A GaAs substrates were electrically characterized using current- voltage (I-V) and capacitance-voltage (C-V) measurements in the temperature range 20–440 K. The analysis of I-V characteristics based on the thermionic emission mechanism has shown a decrease of the barrier height (ϕ_{Bo}) and an increase of the ideality factor (n) at lower temperatures for both hybrid devices. However, the barrier height ϕ_{Bo} value for SPAN/(311)A GaAs device is greater than that of SPAN/(100) GaAs and also is greater than the value reported by Felix et al. [3] for SPAN/4H-SiC hybrid devices. Whereas, the n value for SPAN/(311)A GaAs is less than that of SPAN/(100) GaAs. The higher barrier height and lower ideality factor values for SPAN/(311)A GaAs devices is a proof of its excellent electrical properties and better homogeneity when compared with SPAN/(100) GaAs heterojunction. Moreover, the efficiency of the hybrid devices were evaluated by I-V measurements under light obtained using the AM 1.5 irradiance conditions. The efficiency of SPAN/(311)A GaAs hybrid solar device is approximately five order of magnitude higher than that of SPAN/(100) GaAs. This behaviour is attributed to the effect of crystallographic orientation of the substrates.

Keywords: semiconductor-polymer, hybrid device, Gallium Arsenide, Sulfonated polyaniline (SPAN), diode

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Optical, electrical and morphological properties of antimony telluride nano thin films

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Growth of nano thickness thin films of thermoelectric materials is very important as improvement of the thermoelectric property will not only save material but will enhance uses of thermoelectric devices.
The thin films of various thicknesses were grown using thermal evaporation method. The size and shape of the evaporated nanoparticles were determined by scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDAX) at INUP, IITB and angle dispersive X-ray diffraction (ADXRD) at RRCAT. The optical properties were determined using UV-VIS spectroscopy. The electrical properties were analysed by performing I-V and C-V measurements at INUP, IITB. It was found, that changes in thickness of the thin film result in substantial changes of the growing behavior of the nanoparticles and therefore, seriously different optical properties were observed.

Keywords: Thermoelectric materials, antimony telluride, ADXRD

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84

Electro-optical Properties of ZnO/Al/ZnO Electrodes: Models and Experiments

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This study presents the effects of thicknesses on the electro-optical properties of aluminum (Al) nanolayers embedded in zinc oxide (ZnO) for transparent electrode applications. Numerical modeling was used to study the transmittances (Ts) of ZnO/Al/ZnO (ZAZ) film stacks with Al thicknesses between ~ 1 and 40 nm. Multilayers with mid-Al layer thicknesses between ~ 1 and 10 nm are shown to have average Ts between ~ 75 and 90%, which decreased further with increasing mid-layer Al thicknesses. The simulations are comparable with experimental measurements in multilayers produced using the predicted mid-layer Al thicknesses. The electrical properties are presented for ZAZ multilayers with optimum Al thicknesses between ~ 1 and 10 nm. The results show that the best multilayers have the highest Haacke figure of merit of 4.72 $m\Omega^{-1}$ and sheet resistances as low as ~ 7.25 $\Omega/\square$. These are shown to be comparable to the performance characteristics of indium tin oxide (ITO) anodes that are used currently in organic solar cells and light emitting devices.

Keywords: Multilayers; numerical simulations; optical transmittance; resistivity; solar cells.

Effect of side-chains on charge transport of anthracene-based PPE-PPV copolymers

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Abstract

The variation of the drift mobility of positive and negative charge carriers in films of anthracene-containing poly(p-phenylene-ethynylene)-*alt*-poly(p-phenylene-vinylene))s (**AnE-PVs**), differently substituted, was investigated as a function of the applied electric field. Branched 2-ethylhexyl and linear alkoxy side-chains of different length were considered, as well as well-defined and random distributions of lateral substituents. The same conditions used both for the deposition of the polymer films and for their characterization allowed for the establishment of a clear relationship between chemical structure and charge carrier mobility.

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Organic Semiconductors for Hybrid Solar Cells and Organic Light Emitting Diodes

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Organic semiconductors are widely used in optoelectronic devices, such as light-emitting diodes, solar cells. In this presentation the resent results of the work on the synthesis and properties of charge-transporting molecular glasses performed in the laboratories of the author are reviewed.
We synthesized hole-transporting molecular glasses belonging to the families of condensed aromatic amines, hydrazones, enamines, ethynylenes, stilbenes and electron-transporting materials belonging to the families of aromatic imides. The ionization potentials of hole-transporting materials range from 4.80 to 5.80 eV. Time-of-flight hole drift mobilities in the amorphous films of 2,7-substituted derivatives of carbazole reach 10^{-2} cm^2/Vs [1]. Electron mobilities in the layers of perylene diimide derivatives exceed 10^{-3} cm^2/Vs [2].
The derivatives of 9-phenyl carbazole having dimethoxy-diphenyl amino groups at C-3 and/or at C-positions of the carbazole miety were tested as the components of solid-state TiO_2 based dye sensitized solar cells (DSSC). Using commercial indoline organic dye D102 power conversion efficiency of 3.4% and a fill factor of 0.53 were achieved [3]. Glass-forming star-shaped carbazole trimer tri(9-(methoxyphenyl)carbazol-3-yl)amine also showed good performance as hole conductor in solid-state DSSC. The cells showed a power conversion efficiency of 2.23% with J_{sc} of 8.85 mA cm^{-2} under standard AM 1.5 simulated solar irradiation [4].
Well defined carbazole oligomers have appeared to be effective host materials for blue organic electrophosphorescent devices. The triplet energies of these materials approach 3.0 eV. Using these host materials, blue phosphorescent OLEDs having efficiencies of up to 15 % were demonstrated [5]. Glass-forming diphenilamino-substituted carbazoles were used as guest compounds for the preparation of blue OLEDs based on the phenomenon of delayed fluorescence [6]. The external electroluminescence efficiency of devices reached 17%.
Keywords: organic semiconductor, synthesis, properties, solar cells.

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Heterostructure ZnONWs/MoS2 synthesized by two step electrodeposition method for enhanced photoelectrochemical application

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In recent years, hetero-structure based one-dimensional (1D) nanostructures have successfully shown improved properties in many types of material system due to their superior properties compared with their individual material. As one of the most important wide band gap semiconductor for nanotechnology in today's research, we can cite zinc oxide (ZnO) nanowires [1] with a wide band gap of 3.3 eV and a large exciton binding energy of 60 meV at room temperature. ZnO has attracted many attentions due to their charming performances in photovoltaic energy conversion [2], photovoltaic [3], photocatalysis [4] and piezoelectric systems [5]. However, due to it wide band gap (Eg=3.3 eV), the ZnO material absorbs only UV light, which severely limits its photoresponse to the ultraviolet region. To overcome this problem and meet the increasing demand of global energy, constructing the heterostructure with narrower band gap semiconductor is considered as one promising way to harvest their visible light absorption. Meanwhile, many investigates have been made to enhance the charge separation and improve the optical absorption ability of ZnO under the visible region, such as coupling or decorating with a narrow band gap semiconductor [6–9]. Among these attempts, coupling ZnO with small band-gap semiconductors (such as ZnSe [10], ZnS [7], Cu_2O [11] or In_2S_3 [12] to form hetero-nanostructures is a feasible way to extend the visible light absorption abilities and photoelectrochemical performances of nanostructured wide band gap photoelectrodes. Recently, construction of a hetero-junction between ZnO nanowires and Molybdenum disulfide (MoS_2) which demonstrate a graphene-like two-dimensional semiconductor with intriguing optical and electronic properties, has drawn increasing research interests [13-15]. The wide band gap of MoS_2 (1.29 eV) makes it an ideal choice as an inorganic passivation junction for a variety of semiconductor heterostructure in order to improve the photoelectrochemical response of ZnO under the visible light region [16]. In fact, a variety of methods have been developed to synthesize semiconductor MoS_2/ZnO nanowires for photovoltaic and PEC devices, including chemical bath deposition, sol-gel, and electrodeposition. Among these methods, electrodeposition technique was less expensive easy monitoring of the deposition process and conducted at ambient conditions [17]. To the best of our knowledge, there is no report in the literature regarding the electrochemical synthesis of ZnO_{Nws}/MoS_2 and their photoelectrochimical cell performances.

88

In the present work, we report the synthesis of heterostructure ZnO_{Nws}/MoS_2 by a two-step electrodeposition method onto stainless steel mesh. First, ordered ZnO nanowires were grown vertically onto stainless steel mesh substrates via electrodeposition, and then MoS_2 thin film were directly deposited on the surface of ZnO nanowires via a successive electrodeposition process to form ZnO/MoS_2 heterostructure nanowires. Structural, microstructures, and Optical properties of the electrochemically deposited samples have been investigated to show the interaction between the ZnO nanowires and MoS_2. The photo-electrochemical performances of as-prepared films are also investigated.

Keywords: ZnO_{Nws}/MoS_2 heterostructure; Electrodeposition method, Stainless Steel Mesh substrate; Photoelectrochemical performance.

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Hybrid solar cells : Research progress, challenges and perspectives

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This article aims to review the recent progress and future aspects of hybrid solar cells (HSCs). Different device designs proposed for efficient light harvesting and their advancements have been discussed. We have discussed various parameters limiting their efficiency and their possible solutions. Special attention has been paid to understand the device physics and its fundamental facets. we reviewed the progress of different morphology of hybrid organic solar cells (BHJs), different categories of structures are developed in order to study the effects of addition different semiconducting inorganic (NCs , Nps, QDs…) to the active layer, here we review some major studies in our understanding of the effects are summarized ,compared and discussed.

Keywords: Hybrid solar cells, P3HT: PCBM, Bulk heterojunction. Semiconducting inorganic

90

Characterisation of concentrator solar cells using the LBIC mapping technique

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The increased deployment of concentrator photovoltaic (CPV) systems worldwide and the expected growth of this field in Africa have opened up an increasing scope in the area of characterisation of CPV devices.The solar cells of a CPV module, when under concentration, operate under carefully optimized conditions in terms of the optical, electrical and thermal subsystems of the module. Deviation from the optimum conditions can lead to device degradation and sometimes premature failure. In addition, current reducing defects such as local shunts and optical blockages may be introduced during the various device manufacturing processes which may adversely affect the performance and overall efficiency of the devices. It is therefore, essential to characterize concentrator solar cells with respect to photo-response and device parameter uniformity so as to identify any defects present and to improve the production technology. In this study, the Light Beam Induced Current (LBIC) mapping technique was used to obtain photoresponse maps of a Back Contact Back Junction (BC-BJ) silicon solar cell and an InGaP/InGaAs/Ge concentrating triple junction (CTJ) solar cell from which localised current reducing defects were mapped. Device and performance parameters extracted from the I-V characteristics for the two devices showed that the devices were characterised by high shunt and low series resistances, parameters that are ideal for concentrating solar cell devices, which operate at high current densities.

Keywords: CPV, LBIC, device parameters, performance parameters, photoresponse

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Polythiophene/grapheme oxide as hole transporting layer in perovskite solar cells

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Carbon nanotubes properties have caused researchers to consider using them in several areas such as physics, chemistry, materials, engineering, ecology, social science ...etc. A study of the arc method consists of a novel way of growing CNTs in a liquid solution from an arc discharge generated by carbon rods, by growing CNTs in a plasma zone using carbon gases or solid carbon. An intermittent arc discharge in water, which has several millisecond pulse width, was used to produce carbon nanoparticles and under vacuum.

Keywords: Carbon nanotubes, mass production, arc discharge

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Analysis of Five Parameters model of Photovoltaic cells

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To observe the characteristics of photovoltaic cell under certain changes of parameters the produced model is used. Analytical solution is achieved under certain condition and then numerical analysis with a fixed method is used to find the model. An equivalent circuit consists of photo generated current source, a series resistor, a shunt resistor, a diode and the mathematical equations are analysed to obtain the model by using MATLAB program. The working procedure is also discussed in here and an experiment has been made to get the closure and appropriate idea about the produced model in order to approve the model. To establish produced model we observed the result of the simulation and it was much closer with the produced model.

Keywords: Energy, Simulation, Irradiation, Solar cell, Characterization.

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Solar Cell Network, an approach for Simulation and Parameters Estimation

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Solar energy is the next generation power source and it is the power source as green energy. People of this world need new source of energy to produce power. Here comes the solar energy, it is the lucrative choice for producing the energy. In this work, single diode five parameters model is used for analysis the I-V and P-V characteristics. Solar Cell Network (SCN) is introduced as network of all the tiny single cells from the five parameters model. A theoretical Solar Cell Network (SCN) system is established for analyzing the behavior of the total network. This technique will be used in one sense in order to improve the knowledge of the PV panel and in other sense to better estimate the model's parameters. The simulated behavior of network helped to identify the important parameters like external (shadow, temperature) and internal (resistance, photo current etc.), which have direct impact on the total network. From the simulation of SCN, different types of important information come out. Comparison between this simulated data and with the data including white noise, give the error between real and estimated values. Understanding this error is important to make the better simulator for SCN what is very close to real world scenario.

Keywords: Solar Cell, Solar Cell Network (SCN), Single diode, I-V and P-V characteristics

93

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An approach to constructing permanently porous platforms of ruthenium-tris(2,2`-bipyridyl) with controllable surface areas and backbone functionality

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In this talk, we describe, for the first time and to the best of our knowledge, an approach to constructing permanently porous polymers of the rigid and directional, multitopic, photosensitizer tris(2,2`-bipyridyl), $Ru(bpy)_3$ nucleolus with large surface areas, variable backbone functionality and long-lived excited state lifetimes that can potentially be exploited for applications in dye-sensitized solar cells and heterogeneous photocatalysis.

Keywords: Photosensitizers, DSSC, porous polymers, photocatalysis

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High efficient Nano structured Thin Film Solar Cell

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Thin film solar cells have an extensive research interest. The technology can be used to reduce the cost of the bulk material of photovoltaic devices which paves the road to low cost SCs with long term stability. Our challenge is to find alternatives to compensate tte poor absorption of thin film solar cell. So there is urgent need to trap the light and enhance the efficiency of solar cell with lower cost. This paper discusses a simulation and modeling of different methods used to enhance the absorption, short circuit current and the ultimate efficiency. The simulation results are obtained using 3D FDTD. The suggested grating has side wings that can enhance light guidance through the active layer. Additionally, one dimensional nano-rods are placed on the modified grating along the surface of the active layer. The nano-rods act as a second grating that can be used for multiple light trapping to increase the optical path length. The numerical results show that high efficiency of 43.114% can be achieved using gallium arsenide as active layer with short circuit current of 35.27 mA/cm^2. On the other hand, a novel design of plasmonic solar cell is investigated and analysed. The suggested design has a cylindrical metallic nanoparticles with hydrogenated amorphous silicon (a-Si:H) as an active material. all the effects of the structure geometrical parameters on the absorption are investigated. The numerical results show that 35% absorption improvement is achieved over the conventional thin film solar cell without metallic nanoparticles.

Keywords: Simulation, thin film, plasmonics, grating.

95

Novel Design of High Efficiency Silicon Nanowire Solar Cell

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Abstract

Due to the rising concern of climate change and the sustainability of fossil fuels, the photovoltaics have attracted a great attention for renewable energy technology. Silicon nanowires have been investigated as promising candidates for the third generation solar cells due to their efficient light harvesting, charge separation and carrier collection though reduced Si materials used. The main idea for designing silicon nanowire solar cells is find the most suitable geometry and pillar distributions that can achieve maximum power conversion efficiencies. It has been proved previously by many theoretical and experimental studies that the SiNW with well-defined geometrical parameters such as radius, height, and filling ratio exhibits a much more efficient light absorption in the solar spectrum. The performance of nanowire solar cells have been intensively researched and studied through the diversity of both design and configurations. The designs varied from cylindrical nanowire, cone, pyramid, nano hole and asymmetric hole. On the other hand, the distribution acquired several geometrical (lattice) shapes: square, triangular, hexagonal and decagonal lattice. In this paper, a novel asymmetric nanowire solar cell is introduced and analyzed using 3D finite difference time domain method (FDTD) via Lumerical software. The simulations are carried out for improving the absorption efficiency of the SiNWs within the wavelength range from 300 nm to 1100 nm. The structural geometrical parameters are tuned to maximize the optical absorption and hence the power conversion efficiency. The optimum new designs offers a promising power conversion efficiency of 17.3%, this figure of merit is higher than that of conventional vertical solar cells (5.26 %) and asymmetric nanowires (7.53%). This enhancement could be attributed to the novelty of the proposed design that creates higher order modes which contributed to strong absorption enhancement and higher power conversion efficiency.

Keywords: Solar cell, Power conversion effeincy, nanowire.

Analysis of the ac response of an organic bulk-heterojunction solar cell based on AnE-PVstat:PCBM

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Abstract

We report an analysis of the ac response of a bulk-heterojunction solar cell in a standard architecture made of an Anthracene containing poly(p-arylene-ethynylene)-alt-poly(p-arylene-vinylene)/1-(3 methoxy carbonyl) propyl-1-phenyl[6,6] and C_{60} (AnE-PV*stat*:PCBM) blend, these were made in detail at room temperature [1]. Impedance spectroscopy is showing "backwards" arcs in Cole-Cole figures at low frequencies that are interpreted through equivalent circuit using negative resistances for electrical contacts.

This equivalent circuit model incorporated chemical capacitance (C_μ), recombination resistance (R_{rec}), transport resistance (R_t) and contact electrical resistance (R_{co}) [2]. We have taken R_{co} as negative values in the bipolar regime to theoretically reproduce the small arc shown in the Nyquist plots. In addition, negative capacitance (NC) was observed under positive dc biases in the bipolar regime. The recombination time τ_{rec} decreases with increasing bias voltages. This result is in agreement with the direct Langevin-type bimolecular recombination. We determined the diffusion time (τ_{dif}) and the diffusion length (L_n) and other parameters. Average mobility of global carriers for the device is around 4 10^{-3} $cm^2V^{-1}s^{-1}$ which is in good agreement with that derived using PCBM electron-only devices.

Keywords: AnE-PVstat: PCBM; Negative capacitance; Transmission line model; Negative electrical contact resistance.

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Polythiophene/Graphene Oxide as Hole Transporting Layer in Perovskite Solar Cells

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Abstract

Perovskite compounds have attracted recently great attention in photovoltaic research. Thin layer from polythiophene used as the hole transporting material. Chemical polymerization is the main process to prepare ultrathin polythiophene films which possesses good transmittance, high conductivity, a smooth surface, high wettability, compatibility with PbI_2 DMF solution avoiding damaging layer, and an energy level matching that of the $CH_3NH_3PbI_3$ perovskite material.
Inverted architect, in planar p-i-n $CH_3NH_3PbI_3$ perovskite-based solar cells, affording a series of ITO/polythiophene/$CH_3NH_3PbI_3$/C60/BCP/Ag devices instead of conventional HTM-PEDOT:PSS . Power conversion coefficient (PCE) about of 15.4% with a high fill factor of 0.774, open voltage of 0.99 V, and short-circuit current density of 20.3 $mA \cdot cm^{-2}$. An expected increasing of (PCE) by 1.2 - 1.4% when doping polythiophene with graphene oxide (GO) to become 16.6 - 16.8 % and an increasing in stability is obtained.

Keywords: perovskite solar cells, polythiophene, hole-transporting layer, electrochemical polymerization, graphene oxide.

98

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A Theoretical Study of The Triple-Junction InGaN Solar Cell

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Abstract

Nowadays, the challenge in the field of solar cells is to get a maximum efficiency. The multijunction technology based on InGaN alloy offers the possibility to achieve a high efficiency by absorbing the maximum of solar spectrum. In this work, we have studied theoretically the triple-junction solar cell taking consideration the effect of the temperature and irradiance in its performance. Besides, we have calculated the absorption coefficient of the three sucells.

Keywords: InGaN; Multijunction; Solar cell; Poisson equation; Absorption coefficient.

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Synthesis and Investigation of The Photophysical and Electrochemical Properties of AnE-PV Polymers Bearing Linear and /or Branched Alkoxy Side Chains

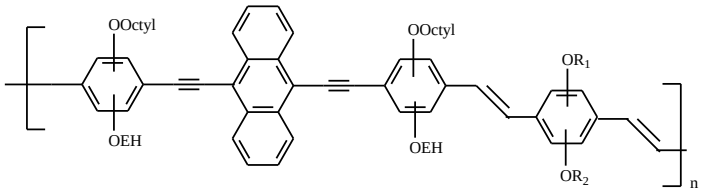
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Abstract

The properties of poly(*p*-phenylene-ethynylene)-*alt*-poly(*p*-phenylene-vinylene)s (PPE-PPVs) can be tuned by structural modifications [1,2]. In this work we focused on the synthesis and characterization of three new anthracene containing polymers (AnE-PV) with an asymmetrical configuration (partial or total) of linear (octyloxy) and branched (2-ethylhexyloxy) side chains on every phenylene unit as shown in Figure 1. The polymers have been prepared by Honor Wadsworth Emmons (HWE) polycondensation reactions of luminophoric dialdehydes and bisphosphonates in different combinations. The purity and the chemical structure of the polymers were confirmed by ^{1}H-NMR and infrared spectroscopy. The photophysical properties have been investigated by UV-Vis and fluorescence spectroscopy in dilute solutions as well as in thin solid films. The thermostability and electrochemical behavior have been studied by thermogravimetric analysis (TGA) and cyclic voltammetry (CV), respectively.



(1) R_1/R_2= EH/Octyl **(2)** $R_1=R_2$= Octyl **(3)** $R_1=R_2$= EH

Figure 1: Schematic drawing of the synthesized and investigated polymers (AnE-PVs)

Keywords: AnE-PV copolymers; alkoxy side chains; electrochemistry, photophysical properties

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Influence of Deep Levels on the Efficiency of InGaAs Quantum Wire Intermediate-Band Solar Cells

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Abstract

Recently, there has been an increasing interest in developing new technologies and novel concepts of producing high efficiency solar cells. For example a great research effort has been devoted to investigate the intermediate band solar cells (IBSC) as an innovative way to enhance the efficiency of solar cells. Usually, a system consisting of zero-dimensional quantum dots (QDs) is used to form an intermediate band in the space-charge region of a single junction solar cell. As a result, photocurrent enhancement could be achieved due to the absorption of photons with energies less than the band gap of the bulk junction material. However, the open circuit voltage decreases resulting in the degradation of the performance of the solar cell. To prevent the drop of the open circuit voltage it was found necessary to dope the intermediate band [1]. In addition, it was observed that doping creates additional carriers in the QDs that enhance the infrared (IR) absorption and the photocurrent.

101

In order to understand the possible mechanisms of the efficiency loss, it is worthwhile to investigate the electrically active defects present in these structures. In this work, we present detailed studies of the quantum wire (QWr) IBSC devices grown by Molecular Beam Epitaxy (MBE) [2]. By using Deep Level Transient Spectroscopy (DLTS), along with temperature dependent I-V and C-V measurements, we were able to characterize solar cells with an IB composed of doped and undoped QWrs. These measurements revealed that the QWrs samples without intentional doping show only one majority trap peak in the DLTS spectra. This dominant peak shifts to the low temperature side during the DLTS scan with the increase of forward bias voltage. The DLTS measurements for the doped QWr IB show both majority and minority traps at different bias voltages.

In addition, C-V measurements at low temperature (~ 20K), performed for both devices, show localization effects, which are observed for forward and reverse biases in the solar cells with a doped QWr IB, while in the undoped QWr devices these only appear in forward bias. The local ideality factors for both samples, which are calculated at room temperature from I-V measurements, show a change with voltage indicating different dominating mechanisms [3, 4] in the currents of QWrs with and without intentional doping samples.

Keywords: intermediate band solar cells, DLTS, I-V and C-V

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Study of Some Materials as Buffer Layer in CuSbS2 Solar Cell Using SCAPS-1D

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Abstract

This study involves the study of thin film materials as buffer in $CuSbS_2$ solar cells. The materials considered were CdS, InS, ZnSe and ZnS. First, the CdS thin film was used to optimize the $CuSbS_2$ solar cell using SCAPS-1D. A base model using CdS was developed, simulated and an efficiency of 3.13% was obtained. Thereafter, the CdS buffer layer was substituted with InS, ZnSe and ZnS respectively. Efficiencies of 0.26% (InS), 1.72% (ZnSe) and 14.36% (ZnS) were obtained with these materials respectively. In conclusion, ZnS thin film is a viable buffer material for $CuSbS_2$ solar cell due to its output performance and non-toxicity.

Keywords: Solar cell, buffer layer, $CuSbS_2$, Efficiency

102

Design of a Renewable Energy Converter for Their Integration to the Power Network

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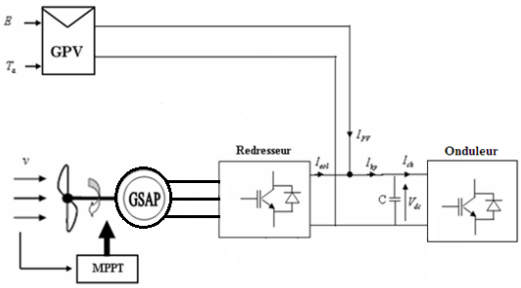
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Abstract

The present paper deals with the study and design of a converter fed by hybrid sources, i.e., wind and photovoltaic generators. This converter aims the possibility of direct integration in the conventional power network.

The proposed Converter is made up of a photovoltaic generator in one hand and a wind generator in the other hand. The idea behind this design is to add the two energy quantities and eventually save part of it so that at lack of any of the energy sources the converter output is always ready to supply energy to the conventional network as is shown in Fig.1.

In order to observe maximum performances, we designed a converter controller based on a microcomputer system as shown in Fig.2.



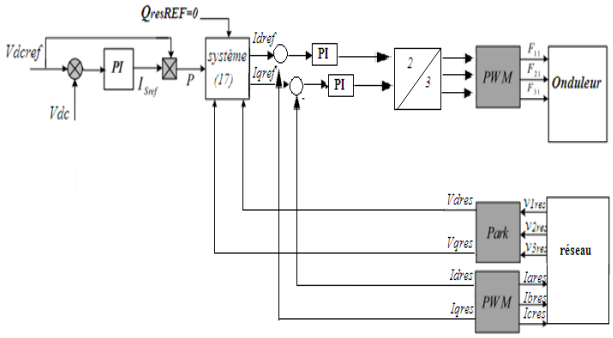


Fig.1 Basic schematic of the Converter
Fig.2 Controlled output converter

Keywords: Electric converter, wind energy, photovoltaic, integration, power network.

First-principle study of structural and electronic properties of copper chloride CuCl for photovoltaics applications

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Abstract

First-principles calculations have been used to investigated the structural and electronic properties of copper chloride CuCl using a recent version of the full potential linear muffin-tin orbitals method (FPLMTO) which enables an accurate treatment of the interstitial regions. The exchange correlation energy is described in the local density approximation (LDA), and the generalized gradient approximation (GGA) using the exchange-correlation potential calculated by Perdew et al. Results are given for lattice parameters, bulk modulus and its first derivatives in in both NaCl (B1) and ZnS (B3) structures. The results of these calculations are compared with the available theoretical and experimental data.

Keywords: FP-LMTO, Structural Properties, electronic Properties, copper chloride CuCl.

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104

Light soaking effect on the conversion efficiency in solar cells based on In(OH)xSy/Pb(OH)xSy

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Abstract

Light soaking characterization on complete SnO2:F/TiO2/In(OH)xSy/Pb(OH)xSy/PEDOT:PSS/Au, eta solar cell structure as well as on devices which do not include one or both TiO_2 and/or PEDOT:PSS layers has been conducted. Addition- ally, studies of SnO2:F/In(OH)xSy/Pb(OH)xSy/PEDOT:PSS/Au solar cell have been performed. The power conversion efficiency and the short circuit current density have been found to increase with light soaking duration by a factor of about 1.6 - 2.7 and 2.1 - 3, respectively. The increase in these two parameters has been attributed to the filling up of trap states and/or charge-discharge of deep levels found in In(OH)xSy. These effects take place at almost fill factor and open circuit voltage being unaffected by the light soaking effects.

Keywords: Eta Solar Cell; Light Soaking; Conversion Efficiency; TiO2; In(OH)*x*S*y*; Pb(OH)*x*S*y*

Comprative Study of Different Silicon Photovoltaic Technologies under Sudano Sahelian Climate

105

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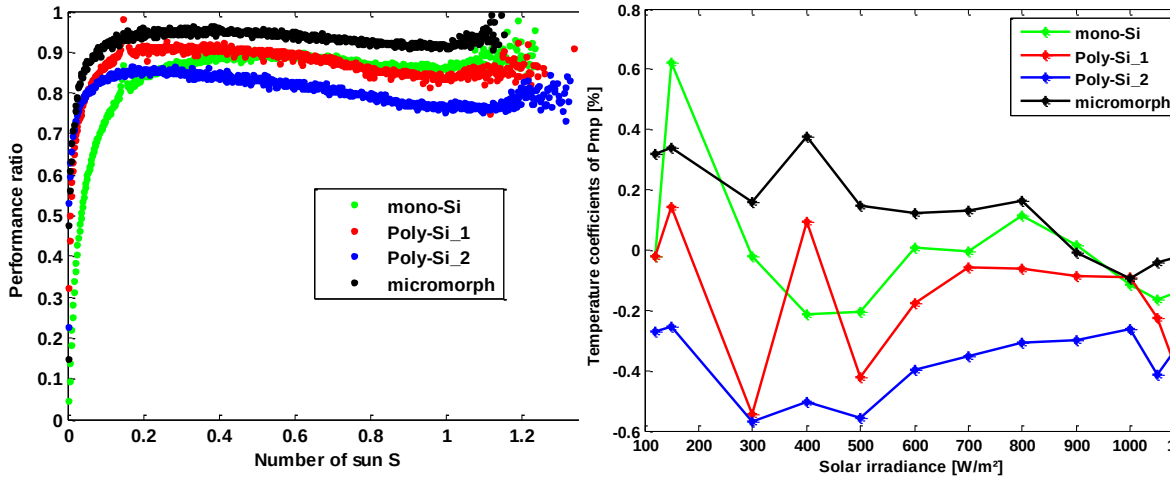
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Abstract

There are nowadays several technologies of photovoltaic modules. Their performances, ageing and lifespan strongly depend on the climate and the environment [1], [2] of their installation site. Therefore, it is difficult without investigation, to know for a given site, the technology which is better suited with the real operating conditions. This paper presents a performance comparison study on four photovoltaic modules. Three different silicon technologies including one monocrystalline (mc-Si), two polycrystallines from different manufacturers (p-Si_1,p-Si_2) and one tandem structure of amorphous silicon also known as micromorph module (a-Si/µc-Si) were selected. The modules I-V characteristics and meteorological data are measured during one year (from August 01st, 2014 to July 31st , 2015) using an outdoor monitoring test facility named "IV bench" and set up at Ouagadougou in Sudano Sahelian climate. The actual maximal power, the average performance ratios, the series resistances and the maximal power temperature coefficient of tested modules are determined from the outdoor measurements and used for comparison study.

As shown the figure below,the obtained results show that the micromorph module presents the best performance on the selected site, with an average performance ratio of 92.48%.



(a) **(b)**

Figure *(a) Module performance ratio and (b) maximal power coefficient temperature.*

The monocrystalline and polycrystalline modules from the same manufacturer have nearby average performance ratio of 84.35% and 84.52% respectively. The second polycrystalline from another manufacturer strangely presents the lowest average performance ratio of 80.45%. A close analysis of this module shows that this bad performance is due to both its larger series resistance and temperature coefficient of maximal power in operating conditions. The same results are obtained when using different modules from the same model (same manufacturer and same STC power).

106

Keywords: Performance ratio; Outdoor exposure tests; mc-Si; p-Si, a-Si/µc-Si

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Electrical and Structural Properties of Aluminium doped Tin Oxide codoped with Sulpher for Solar Energy

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Abstract

Thin films of Tin oxide co-doped with 28at%Aluminum and varied concentration of Sulphur were prepared on 1mm thick, 1cm by 1cm glass substrates at 470^0C by spray pyrolysis technique. Films were produced from 2.0 M solution of hydrous tin chloride dissolved in ethanol with 38% hydrochloric acid concentration, 1.5M aqueous Aluminum chloride and 2.0M aqueous solution of Amonium Sulphide. Effects of Sulphur concentration on structural and electrical properties of transparent Tin Oxide thin films were investigated in the Sulphur content range (0-50) at% with a fixed 28at%Al content. Polycrystalline structures without any second phases were observed with preferential orientations along the (110), (101), (200) and (211) planes. Average grain size as determined from the (110) peaks lay in the range 19.2nm-47.7 nm. The minimum resistivity was found to be $1.15x10^{-3}$Ωcm for the Tin Oxide films doped with 32at%Al content and $9.59x10^{-3}$Ωcm for Tin Oxide films co-doped with 28at%Al and 20at%S content. It was observed that Aluminum doping lowered the grain size significantly but doping to optimum level of 32at%Al content increases electrical conductivity of tin oxide. When Sulphur was intentionally introduced in the crystal structure of 28at%Al doped Tin Oxide, the electrical conductivity decreased appreciably and the grain size increased.

Keywords: Spray Pyrolysis, Transparent conductors, Co-doping.

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Structural and Optical characterization of Tin Oxide codoped with Aluminum and Sulphur

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Abstract

Thin films of Tin oxide co-doped with 28%Aluminum and varied concentration of Sulphur were prepared on 1 × 1 m^2 glass substrates at 470^0C by spray pyrolysis technique. Films were produced from 2.0 M solution of hydrous tin chloride dissolved in ethanol with a few milliliters of hydrochloric acid, 1.5M aqueous Aluminum chloride and 2.0M aqueous solution of Ammonium Sulphide. Effects of Sulphur concentration on structural and optical properties of transparent tin oxide thin films were investigated in the Sulphur content range 0.0-50.0 % with a fixed 28%Al content. Structural and optical characterization of films was measured with Siemens D5000 X-ray diffractometer and Perkin-Elmer Lambda 900 double beam spectrophotometer respectively. Dispersion analysis based on a model of Drude and Kim terms was used to simulate the experimental transmittance and reflectance data. Films with thickness lying in the range 171nm-247nm were analyzed. Polycrystalline structures without any second phases were observed with preferential orientations along the (110), (101), (200) and (211) planes. Average grain size as determined from the (110) peaks lay in the range 19.2nm-47.7 nm. Optical band gaps lay in the range 3.93-4.02eV. It was observed that co-doping lowered the grain size significantly and increased transparency of the oxide.

Keywords: Spray Pyrolysis, Tin Oxide, Transparent conductors, Co-doping

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Synthesis of anthanthrene-containing PAE-PAVs for opto-electronic applications

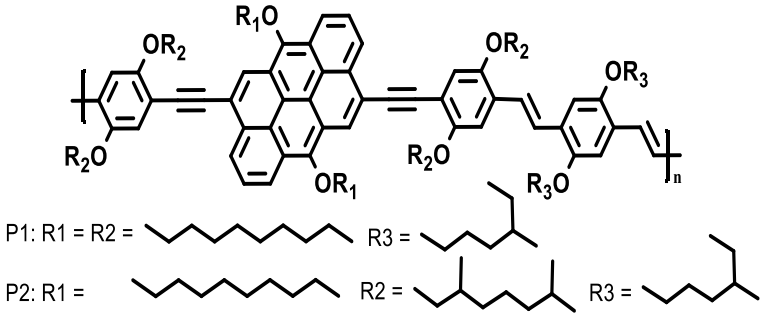
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Abstract

Small molecules and polymeric assemblies of acene derivatives are valuable due to their numerous applications ranging from bioimaging[1] to organic electronics.[2] They exhibit good accessibility for chemical modifications and posses intriguing optoelectronic properties, which can be easily tuned by the number of fused rings.[3] Non-linearly fused polycyclic aromatic compounds are expected to further increase and widen the possibilities for organic electronic applications, due to their extended π-conjugation which is believed to be beneficial since electronic coupling increases with size [4]. Anthanthrene-based small molecules exhibit good stability, solubility and display properties which make them suitable candidates for application as organic electronics materials.[4] Poly(arylene ethynylene)-*alt*-poly(arylene vinylene)s (PAE-PAVs) are an interesting class of conjugated polymers. The combination of poly(phenylene ethynylene)s (PPEs) and poly(phenylene vinylene)s (PPVs) with various arylene building blocks provides a variety of new materials that possess distinct optoelectronic properties. In this contribution anthanthrene is used as a new building block in the synthesis of two anthanthrene-containing PAE-PAVs with specific side chain configurations as shown in the scheme below. Sonogashira cross-coupling reactions were utilized to introduce the ethynylene moieties. The vinylene moieties are formed in the final polycondensation step by the reaction of dialdehydes with bisphosphonates derivatives following the Horner Wadsworth Emmons olefination protocol. Both polymers have the same backbone (-Ph-C≡C-Anth-C≡C-Ph-CH=CH-Ph-CH=CH-) but bear different side chains at the phenylene, decyloxy and 3, 7-dimethyloctyloxy, respectively. The synthesis and structural verifications of these compounds will be presented.



Keywords: Anthanthrene, conjugated polymer synthesis, PAE-PAV.

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Fabrication of aluminium microstructures in PEDOT:PSS buffer layer by using ultrasonic ablation technique for improving organic solar cell efficiency

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Abstract

In the present work, we introduce 40% improvement of organic solar cell efficiency by using aluminium microstructures (Al MSs) dispersed in poly(3,4-ethylene dioxythiophene)-blend-poly(styrene sulfonate) (PEDOT:PSS) buffer layer. Al microstars (in the range of 5-16 ηm) in addition to Al nanoparticles (Al NPs) have been prepared by new ultrasonic ablation technique[1] through the application of ultrasonic irradiation upon Al thin film immersed in PEDOT:PSS solution. In the beginning and as a result of acidic nature of the PEDOT:PSS solution, we found that the PEDOT:PSS solution completely dissolved Al thin film before applying ultrasonic irradiation resulting in specifically Al microcircles, which are dissociated into Al microstars after applying ultrasonic irradiation. The short circuit current density, fill factor, and, consequently, power conversion efficiency of the investigated solar cells have been improved by the incorporation of Al microstars, which can facilitate the transport of charge carriers, specifically holes, to be transferred along the axis of the Al microstars in the buffer layer of the solar cell. We found that the increase in ultrasonication time applied upon the solution of PEDOT:PSS-Al microstars diminishes the length of Al microstars and reduces the number of Al microstars' arms. Therefore, further increase in ultrasonication time decreases the device performance parameters due to the deficit of charge carriers to be transferred in the buffer layer matrix. The Al microstars prepared by ultrasonic ablation technique are pure and free of surfactants and passivation layers that are inevitably present on the surface of the chemically synthesized MSs and NPs. The new ultrasonic ablation method enables us to prepare desirable size of Al microstars, which can be suitable for improving organic solar cells and in other different applications.

Keywords: Organic solar cells; PEDOT:PSS buffer layer; Aluminium microstructures; Ultrasonic ablation technique

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Characterization of Cobalt Doped TiO_2 and Cu:In_2S_3 Nanocomposite Thin Films Deposited by ILGAR Technique for Photovoltaic Applications

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Abstract

Nanocomposite layers have great potential in solar applications with enhanced light harvesting. The nanocomposite films include Cu:In_2S_3 and Co:TiO_2 layers. The nanocomposite materials were characterized in order to determine their morphological and structural properties and also determine the diffusion mechanism of copper in In_2S_3. These films can be used as a buffer layer material in Chalcopyrite solar cells, a suitable substitute of the poisonous CdS currently used commercially. In_2S_3 and Co doped TiO_2 thin films were prepared by Ion Layer Gas Reaction method on glass and crystalline silicon substrates at varying temperatures. The Cl concentration was varied between 7 and 14 at.% by varying deposition parameters while the Cobalt doped Titanium dioxide thin films (CTF) were prepared by doping TiO_2 at different concentration levels of Co which was varied between 0 and 4.51 at. %. The compositional analysis has been done using RBS method. The analysis showed the activation energies and exponential pre-factors for Cu diffusion in Cl-containing samples were between 0.70 to 0.78eV and between 6.0×10^{-6} and 3.2×10^{-5} cm^2/s respectively. The low values promote Copper diffusion in In_2S_3 film. The cobalt doped TiO_2 material was found suitable for application as a dielectric and a Photocatalyst material. The Co: TiO_2 film therefore is a better absorber for chalcopyrite solar applications.

Keywords: Titanium Dioxide, Doping, Morphological and structural Characterization

Structural and Optical Characterization of Polymer based TiO_2 compact films for Photovoltaic Applications

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Abstract

Dye sensitized solar cells (DSSCs) experience a number of challenges as a technology and these challenges have to be overcome before the technology can be competitive enough with the current solar energy technologies now in application. One of the challenges is the loss of electrons through the back contact. Different types of s compact underlayers have been suggested and indeed applied on these solar cells to minimize the electron loss with success. In this paper, we report yet another possible type of underlayer coating that can be applied to DSSCs. An automated dip coating technique has been used to deposit Titanium dioxide (TiO2) using Titanium Isopropoxide as the precursor and Polyvinylidene Fluoride-Co-Hexa fluoropropylene (PVDF-HFP) as the structure directing polymer. Structural studies showed the films to be crystalline with anatase phase preferential. The films thickness was found to increase linearly with withdrawal speed for speeds greater than 0.6 cm/s but assumed almost same thickness for speeds less than 0.6 cm/s. The transmittance of the films reduced with film increase; the lowest transmittance being in the range of 20 % and highest 60-70%.

Key words: compact, underlayer, dip coating, dsscs, TiO_2

112

Comparative study of two secondary optical elements for Fresnel lens as primary optical element

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Abstract

The main idea that motivates a CPV system is the cost reduction by using optical elements to focus light on solar cells and to reduce the systems cost. The optical concentrators generally use a primary and secondary elements to focus and to homogenous the light on the receiver.
In this work, a compound parabolic concentrator (CPC), and a cone are used a secondary elements for CPV optical concentrators and are associated with a Fresnel lens as a primary stage. The achievements concern the performances comparisons in term of concentration, acceptance angle, the output light distribution and the exit angle.
A part of the work concerns the sizing of each element starting from a targeted geometrical concentration ration of 2000x. For the cone the number of inside reflexion is also considered as a parameter for the design. The considered concentrator's efficiencies are used to determine their optimal position facing the lens. The main results are:
The power distribution is more uniform in the case of the cone and it has been found that the efficiency is higher when the secondary element is in the position of of z = f+R/tanθi with f is the focal length; R is the input radius of the secondary optical element. Thus we found that the CPC input radius is larger than that of the cone. Depending of the Fresnel lens diameter, the length of CPC is in opposition way.

Keywords: CPC, Cone, Non-imaging, Fresnel lens; primary optical element, secondary optical element; ray tracing simulation.

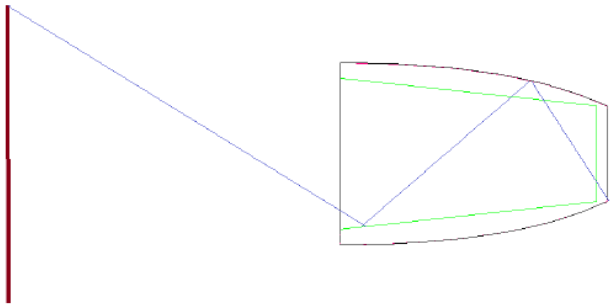


Figure1. Different secondary optical elements (black: CPC, green: cone) with Fresnel lens as primary optical element

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Study on Optical and Structural Properties of Electrospun PS/PES Blended Fibers

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Abstract

For producing fibers out of soluble polymers, electrospinning was used as a promising process for this purpose. PS (Polystyrene) and PES (Polyethersulfone) were blended and used to electrospin a web of fibers at different concentrations and also different applied voltages. SEM (Scanning electron microscopy), UV-Vis spectrophotometer and AFM (Atomic force microscopy) were utilized to characterize the produced fiber samples. By investigating the fiber fineness within the web collected, it was found that the fiber diameter decreased by increasing the applied voltage. Interestingly, without using any colorant or dyeing agents during fiber spinning, it was observed that the web of fibers exhibited polychromatic colours when it was illuminated by light. It was also noted that the spectral colour obtained for each sample was influenced by the blend concentration as well as the fiber diameter. On the other hand, by measuring the contact angles of droplets of various tested liquids deposited onto the surfaces of the fibre samples, the wettability was studied.

Keywords: Optical Properties, colours, wettability

Estimation of Specific Surface Area of Titanate Nanotubes Using Methylene Blue Method

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Abstract

Adsorption of methylene blue (MB) was used to measure the specific surface area of Titanate nanotubes (TNTs). A kinetic study of this dye's adsorption to the TNTs was first conducted to establish the adsorption isotherms. The specific surface area was calculated from this isotherm. The adsorption isotherm was determined at 25°C for 6 hours with the concentration of MB solution in the range 50 to 200 mg L^{-1}. After 6 hours, the concentration of MB at the adsorption equilibrium was analyzed by a spectrophotometer at a wavelength of 660 nm. The specific surface areas for TNTs, was found to be 284.53 m^2 g^{-1}. The reliability of this method seems very good.

Optimal Current Distribution for High Performance Small Antenna

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Abstract

The term small antenna refers to antennas whose maximum dimension is a fraction of the wavelength of the radiated electromagnetic wave. The high Q-factor, low efficiency and impedance matching issues make the design of small antenna challenging. Moreover the performance of small antenna is bounded by fundamental limits developed more than half a century ago. Fractal antennas and metamaterial based antennas are common techniques for antenna miniaturization. Apart from conventional antenna theory based on classical electromagnetic theory, a new understanding of electromagnetic radiation may help in designing smaller antennas with the split between electrical length and physical length but this needs more investigation. All techniques used to miniaturize antenna are subjected to fundamental limitations, a better way to design high performance antenna is to approach those limits. Here, downsizing antenna is done through aperture synthesizing that allows maximal G/Q through surface current manipulation on the antenna. The surface current that gives the high performance is solved using Method of Moments numerically. The optimal current distribution gives high performance for antenna with fixed size that approach physical limits. Electrically small antennas find extensive application such as Wireless Sensor Networks and embedded health monitoring systems.

Keywords: Small antenna, optimal current, fundamental limits, method of moments.

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Poster Presentation Topic 1

Opportunities and Challenges in Egyptian Electric Power Framework

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Abstract

Electric power is by far the pumping heart of current civilizations since the time of Thomas Alva Edison. With current evolving technologies, significant developments can be implemented to the three major phases of electric power flow, namely production, distribution, and consumption. It is argued that our socioeconomical status in Egypt can be levitated through improved utilization of our electric power capabilities. In order to attain this goal, we foresee the need for a comprehensive analysis of our resources, distribution grid infrastructure, and the various consumption sectors of electric power. In this statistical study, it is aimed to draw a detailed picture of the electricity situation in Egypt and to point towards plausible solutions. The collected statistics covered two major parts, namely electricity generation sources and electricity consumption sectors. Also, Egypt's situation was compared with two other countries, one shared similarity to Egypt's situation and another developed country. The analysis of the collected data made it easy to identify the most affected consumption sectors by electricity shortage, therefore pointing out the most suitable solutions for these sectors with the highest possible efficiency and the least cost according to the situation of each sector. The statistics are mainly abstracted from the official annual report of 2013/2014 published by the Ministry of Electricity and Renewable Energy.

Keywords: Egypt, Electricity development, Renewable Energy, Energy output and input.

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Development Strategies of Renewable Energy for Poverty Reduction in Central Africa Case of Chad

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Abstract

The exploitation of renewable energy will not only help to reduce greenhouse gases or the protection of the environment but it will also reduce poverty. In this work, we want to develop these renewable sources of energy for decentralized electrification [1] in isolated rural and urban [2] areas, street lighting with hybrid systems (solar, wind, biomass). Smart irrigation and watering herds in the region of Central Africa by taking the case of Chad as a reference. To carry out our work, we divided it into three parts, respectively studying the access rate, the electricity needs and potential of renewable energy to meet those energy needs in Chad.

Keywords: Renewable, Energy, Poverty, Decentralized, Electrification, Rural, Urban

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Renewable Energy Mapping Using Weather Data & Sensors

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Abstract

Non-renewable resources like oil and gas will no longer be sufficient to fulfil global energy consumption needs[1]. As a result, governments are exerting efforts in searching for more ways to either partially or fully utilize renewable energy resources instead. One of the major factors in maximizing the efficiency of these renewable energy resources throughout the year is location; that is, where is the optimum location for building a solar plant, or a wind farm. The work done mostly by undergraduates details the use of weather data acquisition and analysis techniques in the MENA region in order to determine the most favourable locations for solar and wind energy harvesting.

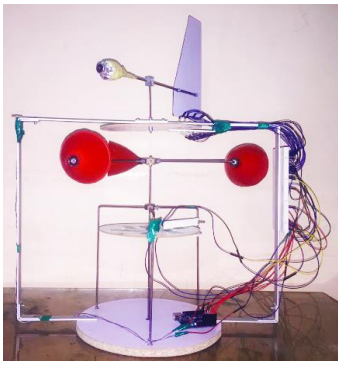


Figure1: Low-cost weather sensor prototype

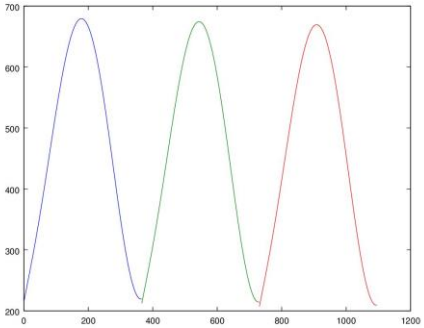


Figure2: Trend discovery within solar readings over 3 years

The work to be presented is divided into two sections: First section detailing a low-cost sensor design to be deployed in remote and unrecorded areas for data acquisition. The sensor features wind speed and directions measurements, as well as light intensity recording for solar measurements. The second section explains mathematical techniques to utilize such obtained data, which is geo-tagged, to create predictions of energy outputs for years to come, and presenting the findings on a map for strategic decision making.

Keywords: Energy-mapping, sensors, solar, wind

Economic analysis of a stand-alone reverse osmosis desalination unit powered by photovoltaic for possible application in the northwest coast of Egypt

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Abstract

The availability of fresh water and energy is the key factor for the development of many countries particularly those of over-populated arid areas. Potable water supply shortage and recent technological development have led to wider application of conventional, and yet advanced saline/brackish water desalination plants. Today, desalination methods require large amounts of energy, which is costly both in environmental pollution and in money terms. This study defines the main economic parameters used in estimation of desa- lination costs and limitation of the stand-alone, small size SWRO plants powered by photo- voltaic (PV) at the northwest coast of Egypt. Moreover, a techno-economic study is made to estimate the actual cost of m3/fresh water production on real field measurements. All cost estimates are based on the prevailing prices during 2012–2013. The average unit cost of desalted water with the desalination unit powered by PV battery is 9.3–5.6 LE/m3, which is very high, but when using the unit with battery, the cost is reduced to 2.3–1.7 LE/m3 by increasing working hours to 24h. Economical strategies should be developed for more reduction in cost, taking into account all phases from site selection and design to operation and maintenance and most importantly increasing the local manufacturing.

Keywords: Production cost; Economic analysis; Reverse osmosis; Photo voltaic; Desalination.

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Improving Electricity Access in Africa through Smat Grid

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Abstract

Only 43% of the African population has access to electricity; and for the regions that have electricity, reliability of supply is a major challenge. The state of the existing national grid systems is incapable of meeting the growing energy needs owing to its obsolete and out dated infrastructure which is characterised by frequent untimely outages and high power losses. Furthermore, over reliance on fossil fuels to meet the rising energy demand poses a threat to the environment.

The move of Africa to a smart grid system will serve as a means to take advantage of the continent's vast renewable resources, improve energy access and curb the rate of environmental pollution. However, upgrading the existing grid would be a costly venture. Building from a case study of Cote D'Ivoire, a strategy for sustainable deployment of smart grid in Africa is proposed which incorporates some applications such as distributed generation and advanced metering.

Keywords: Smart Grid, Electrification, Renewable Energy, distributed generation

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Assessment of the Potential for Utilization of PROSOPIS JULIFLORA as a Renewable Energy Resource for Syngas Production in Small Household in Kilifi County, Kenya

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Abstract

The invasion of *P. Julifrora* in Kilifi County has resulted in a myriad of social and ecological concerns. The plant has interfered with community livelihoods in a number of ways and the surrounding ecosystems. Even though investment in its control has been has been an issue for over a period of time now since the invasion, recent studies show potential of using it to produce bio-energy from the weed and this has generated ample avenues for research, technological development and marketing of its energy products. Marketing for its energy products still faces a number of challenges due to limited technological development and research on the invasive plant. There is thus a greater need to assess the suitability of the weed for energy provision and how it could contribute to energy security in the area. The objective of the study is to assess the potential for utilization of *P. Juliflora* as a renewable energy resource for syngas production in small household in Kilifi County the study will profile pollutants from gasification of *P.Juliflora*, ash content and the elemental composition of residue ash as properties that require consideration with regard to investments in the Kilifi bioenergy industry to provide a sustainable solution in the management of *P.Juliflora* in terrestrial ecosystems while improving livelihoods.

The study will be carried out using analytical techniques. Data will be gathered by analysis of the flue gas from gasification from *P. Juliflora* through laboratory tests in a controlled environment. A flue gas analyzer would be used in the study to determine specific air pollutants. Ash content analysis is will be determined using a muffle furnace while elemental analysis of the ash will employ flame photometry. The emergence of the novel gasification technology that seeks to utilize *P.Juliflora* as feedstock for bioenergy production is not only a breakthrough in clean energy revolution but also a significant step towards the management of this invasive plant in the region.

Keywords: Gassification, Invasive Alien Species, Ecosystems

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Using MLP Neural Networks for Predicting Global Solar Radiation, Case Study

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Abstract

The present work investigates the potential of Multi-Layer Perceptron artificial neural network (MLP-ANN) model to predict the horizontal global solar radiation (HGSR). The ANN is developed and optimized using three years meteorological database from 2011 to 2013 available at the meteorological station of Blida (Blida 1 university, Algeria, Latitude 36.5°, Longitude 2.81° and 163 m above mean sea level). Optimal configuration of the ANN model has been determined by minimizing the Root Means Square Error (RMSE) and maximizing the correlation coefficient (R^2) between observed and predicted data with the ANN model. To select the best ANN architecture, we have conducted several tests by using different combinations of parameters. A two-layer ANN model with six hidden neurons has been found as an optimal topology with (RMSE=4.036 W/m²) and (R^2=0.999). A graphical user interface (GUI), was designed based on the best network structure and training algorithm, to enhance the users' friendliness application of the model.

Keywords: ANN, MLP, Solar Radiation, Modeling, Predicting.

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Experimental Analysis of Elevated Temperature Wire Drawing Using Non – Conventional Oil as Lubricants

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Abstract

Hot working in a wire drawing operation significantly decreases high flow stress and tool force of the material. The work in this paper explained experimentally elevated temperature wire drawing process using neem seed oil and Jatropha curcas seed oil as lubricants, both oils were found satisfactory and dies at temperatures varying from ambient to 600°C. The dies used were made from Hot-pressed Silicon nitride, Tungsten Carbide, High- Speed Steel. The results of an experimental drawing programme was carried out with mild steel and aluminium rod of 8 and 10mm diameter respectively at temperatures between 300 and 600°C. A mathematical model was developed and used to describe and predict the process deformation and both the stress and temperature distribution profile along the work-piece. In conclusion, it was ascertained that wire can be drawn at elevated temperatures using the aforementioned non-conventional lubricants.

Keywords: Wiredrawing, Elevated temperature, Mild steel, Aluminium, Jatropha and Neem oil.

Self-sustainable chicken farm

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Abstract

In a country like Egypt, it has limited sources of fossil fuels and that cause the searching for sources of renewable energy is a matter of national security. Chicken farms are one of the biggest consumers of energy for the use of heating as the chickens needs to be kept at specific temperature along the whole year. Biogas is one of the renewable sources that are offering sustainability due to the availability of the manure and crop residues in the farms.
Our project aims to use chicken manure to produce methane gas to alternate the use of natural or butane gas especially in farms where manure is available for using.

In our project co-fermentation of chicken manure and agricultural residuals of rice are mixed together (treated as composite) and human waste is added also so as to keep the total solid ratio in the digester 25%. Different ratios of the chicken composite and human waste will be made and each time the produced biogas will be measured. Also the PH of the effluent remained after the fermentation will be measured in each case from which we could decide which ratio gives the biggest output of methane.
This project would solve a part of the energy problem in chicken farms besides it has a good environmental impact.

126

Renewable Energy Technologies, Technical and Educational Concepts for the Sustainable Use of Energy- Practical Results from the Center of Electronics and Renewable Energies at Pedagogical University

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Abstract

About 80 % of the Mozambican population lives mainly from agriculture practice (INE, 2011). This activity takes many young people, and as consequences, they are out of school during the day in rural and peri- urban areas, thus compromising the objectives of the Mozambican government with regard to access to education for all. In Mozambique, education is seen as a key factor for building a just, equitable and inclusive and equal opportunities for all citizens. This enables a better socio- cultural integration of individuals in different areas of economic, political and social development. In this perspective, Technical training programs and education society for renewable energy (especially adolescents, youth and women) play an important role in socio -economic development of the country; as well as create the foundation for the growth of various forms of employability, allowing poverty reduction, access to power, existence of skilled technicians in technical materials on photovoltaic technology in Mozambique. In this context, the Electronic Center and Renewable Energy (NEER) of the Pedagogical University have been carrying out successful programs of training and technical education within and outside of universities. On the basis of the methodology : a) theoretical and constructivist practices; b) demonstration classes ; c) work in groups and d) roles Games, the technicians, among other skills , are able to: (i) promote, sell and install Photovoltaic systems ; (ii) the maintenance and repair of Photovoltaic Systems; and (iii) consider the technical, economic and environmental impacts of renewable energy. The big challenge now of NEER is to support the implementation of Literacy Programs and Youth and Adult Education with the help of Radio, Television and Alternative Sources of electricity generation. On the basis of an interdisciplinary theoretical and practical framework of the areas of Renewable Energy, the Environment and Education, the qualitative and quantitative results achieved by the NEER in training technicians are positive practical solutions identified and emerging problems in urban areas, peri- urban and rural areas in Mozambique.

Keywords: Education, Environment, Renewable Energy, Sustainable Development.

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The Role of Human Resource Management Strategies in the Development of Working Women's Behaviours toward the Use of Renewable Energy: Company (A) as Study Case

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Abstract

The solar energy industry has grown tremendously and is still growing and expanding its applications according to the IEA'S statistics. In Egypt the contract of Engineering and Consultation services for the first Egyptian station for generating solar thermal electricity has been signed in early October,2003.The capacity of this station is 127 megawatt with a yearly capacity 900 million KW/h (Abdul Hammeed, 2010). The Development of renewably energy technologies requires the cooperation between the relevant parties and the acceleration of the process of the human resources development and manufacturing systems (Al-Khayyat,2008).This technologies contributes to creation of comprehensive development and the utmost utilization of human resources that is capable of converting the development plans into practical reality (Zayid, 2003; UNDP, 1995), whereby the human resources will make up for the scarcity of natural resources (Judah, 2010) through the strategic role of the management of human resources which emphasizes that individuals (men and women) are valuable resources and that they represent important and effective investment (Mathis&Jackson,2011:9).

The activation of the woman's role in the integrated development process and giving her a greater responsibility in the decision positions, thus the activation of her role is a process that has many interacting many dimensions which adds new dimensions to the role of woman in terms of dealing with the shortage of natural resources and the management of renewable resources like the alternative energy (Zayid, 2003). But, to what extent, can the role of the human resources strategy affect the development of woman's behaviour in the rationalization of the consumption of renewable energy?". This paper focuses at enhancement and promotion of woman's role and participation in the dissemination of Renewable energy in the process of sustainable development purposes and the emphasis on role of Egyptian woman as a pressuring force to change the consumption patterns and habits and the minimization of pollution. The study concentrates on women working in an Egyptian Company as a case study which depends on the solar energy. This paper aims to: 1) Illustrate the role of working women and their participation in the expansion and application of the concept of renewable energy and the identification of types of behaviour and the rationalization of consumption. 2) Illustrate the effective strategies in the management of the natural resources and its impact on the development of working woman's behaviour to rationalize the consumption of renewable energy. In order to achieve the above mentioned objectives, the study adopted the descriptive analytical method in which it starts by reviewing literature and then field research through conducting thorough interviews with research samples and then collecting and statistically analyzing data in order to verify the validity of the hypotheses of the study.

Key words: human resources management, renewable energy, women empowerment, human resources strategies

128

Effect of Collector- Chimney Junction on the Flow by Natural Convection in a Solar Chimney

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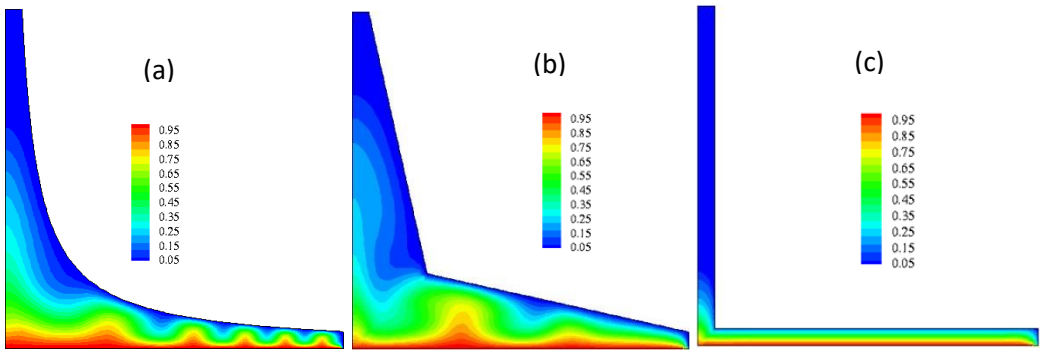
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Abstract

The solar chimney is a simple solar thermal plant that is capable of converting solar energy into thermal energy in the collector. In the second step, the thermal energy is converted into kinetic energy in the chimney and ultimately into electrical energy using a combination of a turbine and a generator. On the physical plane, the solar chimney is a complex energetic system in which all the different modes of heat and mass exchange are involved. If they are relatively simple and well known, their coupling leads to difficulties in the modeling the system. In the present study we have simulated numerically the heat transfer by natural convection in a solar chimney. We analyze the influence of the nature collector-chimney junction on the heat transfer in the system. As a boundary condition, the soil is maintained at a constant temperature higher than that of the collector. The numerical simulations were performed for three geometric configurations and the Rayleigh numbers going from 10^3 to 10^5. The results showed that the geometric characteristics much influential on the transfer it is better when we considered a curved junction between the collector and the chimney.

Keywords: Applied Solar Energy, Solar chimney, Nature of Junction, Natural convection



Isotherms for Ra=10^6, (a): curved junction, (b): oblique junction, (c): right junction

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Cost Effected Environment Friendly Sustainable Model

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Abstract

The dream of a real change can best come true through cost-effective, environment friendly and sustainable pragmatic approaches rooted in indigenous knowledge and practices Inspire to design, invent, and make an Impact, living by this philosophy Safdar Hussain, an inspiring fellow and initiator of cost-effective, environment friendly and financially sustainable model for IDSP's University of Community Development, has sparked the curiosity of many searching for alternative development models with in the local context. Based on the indigenous wisdom, knowledge and economic activities, the model empowers the local people and engages local technology and materials. The university building is a glowing example of this model. The building is made of mud, a traditional substance, found in abundance in the vicinity and has no expiry date with durability longer than cement and concrete. This not only stimulates the local economy through usage of traditional material and local human resources but also asserts their cultural and social uniqueness. The model not only preserves the traditions but also is cost effective. Mud building requires less energy resources as it remains moderately cool in summer and warm in winter season. The model uses solar-panels, wind turbines and bio gas plants to fulfill energy requirement. The question of university financial sustainability is resolved through cultivation of organic flowers and fruits that generates enough income making it self-sufficient. Rain water is stor ed to fulfill the domestic requirements of the university and for cultivation as Baluchistan faces an acute water shortage problem. The model demonstrates self reliance, self sufficiency and traditional wisdom. This replicable model is an example for the youth and communities across Pakistan. It illustrates that a resource-rich country like Pakistan can progress and develop through indigenous knowledge and traditional wisdom rather than depending on external support. We the people have the real power to change anything, so let that change be positive

130

Topic 2

Novel Approach towards the Production of Reduced Graphene Oxide

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Abstract

Graphene is a single layer of carbon packed in a 2D hexagonal lattice. It has great interest because of its excellent electrical and optical properties[1] and could be widely used in energy applications such as photovoltaic solar cells and hydrogen storage. However, the preparation of graphene nano-sheets with low concentration of defects and functional groups is crucial for many of its applications and high-yield production is still challenge[2]. Accordingly, this work aims to synthesize graphene nano-sheets with better quality in large scale and low cost by developing new eco-friendly exfoliation and reduction of graphite Oxide layers. The obtained results, including XRD, UV, TEM, SEM and IR confirmed the successful exfoliation and reduction of graphite oxide into graphene nano-sheets.

Keywords: Thermal exfoliation of Graphite Oxide, Graphene nano-sheets, Graphene Oxide.

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131

Electrodeposited Cobalt Oxide Nanoparticles on Carbon Nanotubes as an Efficient Electrocatalyst for Oxygen Reduction Reaction (ORR) in Alkaline Media

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Abstract

Oxygen-reduction reaction (ORR) is an important reaction in many energy conversion and storage related electrochemical devices such as fuel cells, metal–air batteries, and chlor-alkali electrolysis [1, 2]. To enhance the performance of such devices, searching for cost effective catalysts with maintaining high activity and durability for the oxygen reduction reaction electrodes is highly demanded. To date, Platinum (Pt) and its alloys are the most active catalysts for ORR which limits the widespread commercialization of these devices as result of the high cost of Pt and its scarcity [3, 4]. Accordingly, many efforts have been devoted to replace Pt with other nonprecious catalysts. Among the non-noble catalysts are the metal oxides of transition metals, in particular, cobalt oxides have found to be high active to catalyze the ORR in alkaline media. It has been also found that the catalytic activity of the metal oxide catalysts highly depends on the coupling between the support and the oxides species as well as the type of the supporting carbon materials [5-8]. In our work, we will present a highly simple and affordable approach for electrosynthesis of cobalt nanoparticles (CoOx) on oxidized carbon nanotubes (CNTs). The electrodeposited catalysts were characterized with structural methods and finally their the electrocatalytic activity was evaluated electrochemically towards ORR in 0.1 M KOH using linear sweep voltammetry (LSV) combined with rotating disk electrode (RDE) technique. The kinetic parameters of ORR on the prepared catalyst electrode were calculated from RDE measurements. The results showed that ORR on the CoOx deposited directly on glassy carbon (GC) electrode (CoOx/GC) behaves the two electron pathway mechanism (formation of H_2O_2, not the favorite pathway). On the other side, the coupling of electrodeposited CoOx with carbon nanotubes (CoOx/CNTs) made the ORR to behave the four electron pathway mechanism with number of electrons very closed to 4 electrons (water formation with 4 electron pathway); the same mechanism on the Pt noble catalyst. The highly catalytic activity of the electrodeposited CoOx/CNTs catalyst could be attributed to the synergetic coupling between the electrodeposite CoOx and CNTs support enhancing the electrical conductivity of the electrode and creating more active sites for ORR. Moreover, the prepared CoOx/CNTs catalysts showed higher tolerance towards methanol electrooxidation as confirmed by the chronoamperomertic measurements which provide them as good promising cathode catalysts for alkaline direct methanol fuel cells.

Keywords: Electrodeposition, Cobalt Oxide Nanoparticles, Carbon Nanotubes (CNTs), Oxygen Reduction Reaction (ORR), Fuel Cells

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133

Concentrated Solar Power - A Pathway to Clean and Sustainable Energy Development in Nigeria

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Abstract

The use of conventional technologies to generate electrical power normally results in pollution that affects the environment. It often relies on the burning of fossil fuels that emit dangerous gases that often end up in the atmosphere. People and animals breathe in the polluted air and plants absorb the pollution**.** Concentrated Solar Power (CSP) involves power generation by concentrating solar energy to generate steam and drive turbines. The end result is that if more electricity is going to be produced and consumed from solar energy, we are going to be living in a more healthy environment, with more comfort, more savings, and of course with greater life expectancies. This paper highlights and reviews the potential of using Concentrated Solar Power technology for power generation for ensuring a clean and sustainable energy production in Nigeria and the need for support by adequate funding through research grants and patronage by governments, corporate bodies and individuals.

Keywords: Conventional technology, fossil fuels, Concentrated Solar power, Sustainable energy

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Wind Speed Forecasting in Three Different regions of Morocco, Using a Multiple Regression

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Abstract

Wind energy is known for its random nature which affects the forecasting accuracy of the wind speed. In the present work, we study the forecasting of hourly wind speed using the multiple regression method for three different regions in Morocco (north,north-east,south). The method consists to reduce the number of parameters and only include the most effective parameters to build a regression model between predictors and the dependent variable. The results show a very good accuracy level determined by the coefficient of determination equal to 0.99 and the Mean Square Error(MSE) limited to 0.03 m/s.

Keywords: Wind energy, Wind speed, Forecasting, Multiple regression

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Experimentally Studied on the Thermal Performance of a Solar Water Heating using a Surface Concentrator

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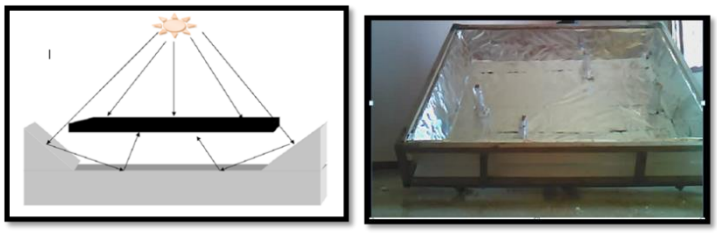
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Abstract

With the growth in energy demand in the world and in order to reduce the emissions of the greenhouse gases in the atmosphere. In addition to the large solar potential, Algeria has decided to put itselfe in place a strategy in order to develop the various applications of renewable energy. Among the most promising applications we have the solar water heating. The Solar Water Heating (SWH) is a system that allows simply the production of the domestic hot water from solar energy.This present work, port on the experimental study of the effect of concentration surface of solar radiation incident on the thermal performance of a solar water heating. For perform this work, first of all we realize a solar water heating with and without a surface concentrator. We compared the experimental results from the simple solar water heater (without surface concentrator) with those of a solar water heater with surface concentrator in the same climatic conditions to highlight the evolution of the thermal performance of the (SWH) considered, essentially, the fluid outlet temperature, thermal energy conveyed and the thermal efficiency is increas.

Keywords: Solar water heater; Surface concentrator; Experimental study; Algeria.



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Structural, Electronic, Optical and Elastic Properties of the Complex K_2PtCl_6-Structure Hydrides $ARuH_6$ (A = Mg, Ca, Sr and Ba): ab Initio Study

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Abstract

We report a systematic investigations of the structural, electronic, optical and elastic properties of the ternary ruthenium-based hydrides A_2RuH_6 (A=Mg, Ca, Sr and Ba) within two complementary first-principles approaches. We describe the properties of the A_2RuH_6 systems looking for trends on different properties as a function of the A sublattice. Our results are in agreement with experimental ones when the later are available. In particular, our theoretical lattice parameters obtained using the GGA-PBEsol to include the exchange-correlation functional are in excellent agreement with experiment. Analysis of the calculated electronic band structure diagrams suggest that these hydrides are wide indirect band gap materials and are expected to have a poor hole-type electrical conductivity. The TB-mBJ functional has been successfully used to correct the deficiency of the standard GGA and LDA for predicting the optoelectronic properties. Calculated density of states spectra reveal that the topmost valence bands consist of *d* orbitals of the Ru atoms, so these materials can be classified as type-*d* hydrides. Analyse of charge density maps tells that these systems can be classified as mixed ionic-covalent bonding materials. Optical spectra in a wide energy range from 0 to 40 eV have been provided and the origin of the observed peaks and structures has been assigned. Optical spectra in the visible range of solar spectrum suggest these hydrides for use as antireflection coatings. The single-crystal and polycrystalline elastic moduli and their related properties have been numerically estimated and analysed for the first time.

Keywords: Structural, elastic, electronic, chemical bonding ab initio calculations, Electronic band, densities of states, Charge density.

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Near-Field Focused Arrays for Energy Harvesting Applications

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Abstract

The ability of planar arrays to focus their beam in the near field region can be of great importance in energy harvesting applications. A detailed study of different types of planar square arrays has been made to describe the limitations on the array size and the inter-element distance with respect to the focal distance and the size of the focused spot. Comparison between arrays of short dipoles and rectangular patches has been made to describe the effect of the element factor on the size of the focused spot. Numerical results obtained using Matlab has been verified through comparison with full-wave electromagnetic simulations.

Keywords: Antenna arrays, planar arrays, near-field focusing, microstrip antennas.

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138

Decontamination of Liquid Effluent by Photocatalytic Reaction

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Abstract

The worn water depollution and the cleaning of drinking water reserves are a major concern today. Among the most recent progress in the water treatment, the advanced oxidation processes AOP (Advanced Oxidation Process) bring a solution proving their effectiveness, allow mineralization in an aqueous medium of the toxic organic molecules to humans and environment. This study describes a new rejection treatment process not biodegradable which is the heterogeneous photocatalysis: it is a combination of a semiconductor catalyst, with an ultraviolet light source that is the sun; it has the added advantage not to introduce additives into the medium to be treated. In a context with high rates of sunlight as is the case of our country, the use of solar radiation for the treatment of chemical and microbial pollution in water would be an asset. Solar photocatalysis progressively became an alternative technology for water depollution; it falls under a durable development prospect using the sun like renewable energy source.

Keywords: depollution, mineralization, biodegradable, Solar photocatalysis, semiconductor catalyst.

Microbial Fuel Cell for Electricity Generation and Waste Water Treatment

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Abstract

Energy problem is a global issue that has a serious effect on many countries in the world. The demand for energy is currently growing far greater than the supply of the nationally generated energy. In order to overcome energy crisis and the output pollution of the generation, it is suggested to use the Microbial Fuel Cell (M.F.C). M.F.Cs are devices that use bacteria as a catalyst to oxidize organic and inorganic matters and generate electric current. With the modifications that are suggested by this study, there will be clean, available and suitable energy source. Also, it can help in water desalination besides having the property of being efficient, eco-friendly and cheaper than the other resources. In addition to all these features, they are expected to utilize the sewage to generate electricity and produce clean water, which mean cleaner environment with a great supply of energy and clean drinkable water. Facing challenges that affect the development of the M.F.Cs is an important aspect to be studied, so our study suggested solutions nearly for all the challenges facing them like the types of the electrodes, output pollutants and the catalyst in the cathode chamber.

Keywords: Microbial Fuel Cell (M.F.C), Bacteria, Electrodes, Substrate.

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Technical Study of a Photovoltaic Site in Bouira- Algeria

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Abstract

Photovoltaic energy (PV) is constantly expanding. The use of PV energy is very useful in isolated areas where the extension of the conventional electricity grid is very delicate that is why we modeled and simulated our photovoltaic system connected to single-phase network and more classical three-phase connection, taking into account the technical characteristics of our locality Bouira (important city existing in the north of Algeria, the country that can meet the electricity requirements of the whole world). For this we analyze the modeling and simulation of a photovoltaic (PV) system. The development of a mathematical model that accurately represents the actual photovoltaic panel and reflects the influence of different weather conditions on the parameters of the solar panel. The different results obtained are in good agreement with those obtained by the designer (solar).

Keywords: Solar energy, photovoltaic cells, optimization, electric network connection.

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The effect of pH solution precursor of TiO_2/FTO thin film electrodeposited on their morphological, optical and photoactivity properties

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Abstract

A series of titanium dioxide (TiO_2) thin films on fluorine doped tin oxide (FTO) were successfully synthesized via electrochemistry method using an aqueous peroxo-titanium solution as a precursor. Cyclic voltammetric experiments were performed between -0.2 to -1.3 V which led to the formation of TiO $(OH)_2.H_2O$ gel film on the FTO; subsequently, this gel was subjected to a heat treatment in air for 1 hour to obtain crystalline TiO_2 thin film (1). In this paper, data concerning the effect of pH precursor solution towards the development of TiO_2 nanoparticles is reported. The samples were characterised by Scanning Electron Microscopy (SEM), UV-Visible Spectroscopy and photoelectrochemistry. Surface morphological study obtain from SEM micrograph showed the effect of pH solution on the particles size, so, when pH increase the grain size increased. Optical study Results show a stronger absorption in the UV range for all films. On the other hand the band gap energy increases when the pH solution precursor increased. The electrochemical and the photoelectrochemical characterizations were carried out for the films obtained using the cyclic voltammetric, chronoamperometry and impedancemetry techniques (2). Finally, Photocatalytic activity of the film prepared at pH = 1.8 for the decomposition of methyl orange (MO) was investigated.

142

Keywords: Titanium dioxide, fluorine doped tin oxide, electrodeposition, photodegradation.

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Stability and degradation of polyethylene-based anion-exchange membrane for alkaline fuel cell and electrolyser application

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Abstract

Alkaline anion exchange membranes (AAEM) for fuel cell applications were fabricated using polyethylene as the base polymer offering a low cost AAEM. Polyethylene films were grafted with vinylbelnzyl chloride (VBC) via radiation-induced mutal grafting and were subsequently functionalized with trimethyl amine (TMA) to produce the AAEM. LDPE-based AAEM prepared with 50 μm initial LDPE thicknesses exhibited ionic conductivity of up to 0.12 S cm-1 at 70 °C and 100% RH. The fabricated LDPE-based AAEM showed long term stability at temperature of up to 80 °C exhibiting essentially constant conductivity of 0.10 Scm^{-1} over a period of 7 months. The membrane showed a degradation rate of 3 mS month-1 under nitrogen and 16 mS month-1 under oxygen. Stability test of the AAEM in deionised water at 60 °C for 3 months revealed degradation due to the removal of functional groups from the polyethylene backbone. 13C solid-state NMR spectra revealed degradation of the membrane evinced by the presence of VBC and TMA functional groups in the degradation products. The use of a more thermochemically stable head group was subsequently investigated. Instead of TMA, 1,4-diazabicyclo[2.2.2]octane (DABCO) was used as functionalizing agent to impart stability owing to its bulky structure. Surprisingly, DABCO-functionalized AEMs also exhibited degradation upon subjecting to 60°C for 3 months. 13C SS-NMR spectra of the degradation product revealed the detachment of DABCO from the LDPE-g-VBC copolymer. Other functional head groups were subsequently investigated.

Keywords: polyethylene, anion-exchange membrane, membrane degradation

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Study of the Effect of Construction Parameters on the Operation of a Solar Distiller to Greenhouse Effect

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Abstract

Of all natural resources, solar energy is the dominant power, it ensures life on earth long ago and exploited by man in various forms such as for solar distillation. It is in this framework that fits our work aimed the study of the effect of changes in construction parameters on the operation of a solar still seen in the optimization of its performance. For this, we performed a numerical study by the development of a computer code in FORTRAN language. This study allowed us to get results graphically and followed by a detailed analysis.

Keywords: Stiller; Building parameters; optimization; numerical study.

Design, Construction and Installation of Solar Water Heating System for Bayero University Kano, New Campus Clinic

144

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Abstract

Solar water heating system was designed, constructed, and installed at the new campus of Bayero University, Kano, Nigeria at latitude 12.1^{o}N. Two flat plate collectors of 1m^2 each was constructed using locally available materials the collectors were covered with single glazing of transparent glass. The surface of the collectors was darkened with black dull paint of emissivity of 0.95 in order to improve its absorption capacity. Assumed solar radiation of 620W/m^2 in the month of December was adopted for the design of 150 litres capacity hot water storage tank with an additional 500 litres capacity cold water storage tank. The collectors were connected in series and assumed to operate on the same efficiency. The two collectors were expected to heat water from a temperature of 25^{o}C to at least 70^{o}C for various applications in the clinic.

Convective Heat Transfer Between Co-axil Rotating Cylinders

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Abstract

Convective heat transfer at the entrance region of an annulus between two axially horizontal cylinders with heated inner cylinder has been performed numerically. ANSYS Workbench Release 15.0 is set up to solve a three-dimensional laminar fluid flow and heat transfer in annulus using ANSYS FLUENT fluid flow system. Air (with Prandtl number = 0.74) is considered as working fluid between inner cylinder with diameter 0.05, 0.1 diameter of outer cylinder and length of 0.5. The inner wall is subjected to constant heat flux and the outer wall is at constant temperature .This study covers Reynolds number varies from 340 to 1540 and inner cylinder rotational speed varies from 0 to 600 rpm. The effect of inner cylinder rotational speed and the inlet Reynolds number on the velocity, temperature profiles and on the heat transfer process in a horizontal annulus will be studied. Local and average Nusselt number and skin friction coefficient are obtained. The effect of inner cylinder temperature on heat transfer process will be also presented. Good agreement between results obtained from present work and Results remarked from the literature is recognized.

Keyword: Laminar flow, CFD, Co-axil rotating cylinders, horizontal annulus, ANSYS FLUENT.

Topic 3

Characterization of Cobalt Doped TiO_2 and Cu:In_2S_3 Nanocomposite Thin Films Deposited by ILGAR Technique for Photovoltaic Applications

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Abstract

Nanocomposite layers have great potential in solar applications with enhanced light harvesting. The nanocomposite films include Cu:In_2S_3 and Co:TiO_2 layers. The nanocomposite materials were characterized in order to determine their morphological and structural properties and also determine the diffusion mechanism of copper in In_2S_3. These films can be used as a buffer layer material in Chalcopyrite solar cells, a suitable substitute of the poisonous CdS currently used commercially. In_2S_3 and Co doped TiO_2 thin films were prepared by Ion Layer Gas Reaction method on glass and crystalline silicon substrates at varying temperatures. The Cl concentration was varied between 7 and 14 at.% by varying deposition parameters while the Cobalt doped Titanium dioxide thin films (CTF) were prepared by doping TiO_2 at different concentration levels of Co which was varied between 0 and 4.51 at. %. The compositional analysis has been done using RBS method. The analysis showed the activation energies and exponential pre-factors for Cu diffusion in Cl-containing samples were between 0.70 to 0.78eV and between 6.0×10^{-6} and 3.2×10^{-5} cm^2/s respectively. The low values promote Copper diffusion in In_2S_3 film. The cobalt doped TiO_2 material was found suitable for application as a dielectric and a Photocatalyst material. The Co:TiO_2 film therefore is a better absorber for chalcopyrite solar applications.

Keywords: Titanium Dioxide, Doping, Morphological and structural Characterization

Optical and Thermal Properties of Perylene /Polycarbonate Composite Used in the Greenhouse Application

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Abstract

Perylene/Polycarbonate composite layers have been prepared by solution-casting method. The optical absorption of Perylene/Polycarbonate composite was studied in the range (400 nm-1100 nm) for different concentration of Perylene from 50 ppm up to 200 ppm, which showed an absorption characteristic peak at 574 nm increased with dye concentration. The detection of fluorescence of polymer composite illustrated a fluorescence peak at 609 nm with maximum intensity at 150 ppm. The polymer composites have been characterized by using DSC, TGA, and FT-IR which did not illustrate any structure variation with the addition of Perylene dye up to 200 ppm.

Enhancement of the Photoluminescence Properties of a Hybrid Nanostructure of Conjugating Polymers with Inorganic Nanoparticles

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Abstract

The hybrid materials consisting of conjugated polymers and semiconductor nanocrystals are of great importance in the quickly growing field of hybrid organic/inorganic electronics since they can serve as active components of photovoltaic cells, light emitting diodes, photodetectors and other devices. In this work we study the effect of the thickness of the conducting polymer layer onto the surface of Indium Tin Oxide (ITO) coated substrates in its photoluminescence properties, also we demonstrate to add some inorganic nanoparticles to enhance this property. The spin coating is the major technique used in this study and the characterization will established using a verity of techniques including SEM, XPS and Impedance spectroscopy. The photolumenesence properties were evaluated using PL. Results of preparation and characterization of conducting polymers is presented and will be addressed during the conference.

Keywords: Conducting Polymers, inorganic semiconductor, spin coating Technique.

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Design of the PV Array Emulator with Fast Response to Testing Power Condition Devcies

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Abstract

It is difficult to test PV inverter with a real outdoor PV array as the array significantly depends on the environmental factors such as the irradiance and temperature. While, the indoor test of a real PV array is impracticable. Thus, the time and the cost of the experiment can be reduced when the PV array emulator (PVAE) is used. This paper presents a fast response of photovoltaic array emulator design based on a buck converter. Furthermore, the PV emulator can be used to study transient response and behavior of power condition devices. Equivalent solar cell is modelled in PSpice based on a real GaAs single solar cell. Then it is used to investigate the effects of parameters variation of solar cell such as temperature, irradiation and losses. A I-V curve is designed according to equivalent circuit of solar cell, which is used to generate I-V curve of emulator. This curve is implemented to design the PV array emulator by controlling a buck converter. A PVAE consists of a DC/DC buck converter with the output feedback voltage controller. The I-V characteristic generator of the PV array emulator is used as desired reference. A fast time response is achieved by using analogue computation circuit. Experimentation results derived from laboratory match closely the numerical modelling of PVAE in MATLAB/SIMULINK.

Keywords: photovoltaic array emulator (PVAE); buck converter; Analogue Computation Circuit, Maximum Power Point Tracking (MPPT)

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Phase-Change, Structural and Magnetic Studies on the Annealed Mg0.15Sr0.05Mn0.8Fe2O4 Nanoferrites

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Abstract

Phase-Change materials are of technological interest due to the changing properties with annealing and also the transition mechanism. The as-prepared $Mg_{0.15}Sr_{0.05}Mn_{0.8}Fe_2O_4$ nanoferrites were prepared by the co-precipitation method and were annealed at different temperatures T. XRD, TEM, IR, VSM and Mössbauer techniques were used to characterize the samples. The phase transformation from cubic spinel at $T \leq 500$ ºC to Z-type hexagonal phase at $T \geq 700$ ºC were proved using XRD patterns and IR spectra. The structural parameters confirmed the transformation process, at which Jahn-Teller effect of the Mn^{3+} and Fe^{2+} ions and/or atomic disorder in the sample crystal lattice are the main factors affecting this phase transition. The lattice constants *a* and *c*, crystallite size R and IR octahedral band position showed dependence on T. The deduced average particle size from TEM images was slightly higher than R. The magnetic parameters (saturation magnetization M_s, coercivity H_c, remnant magnetization M_r, squareness M_r/M_s and magnetic moment n_B) were affected by the transformation process and showed T dependence. The complimentary analysis of Mössbauer spectra and the study of the hyperfine interaction parameters of the tetrahedral A-sites and octahedral B- sites and the area ratio of B- to A-sites (B/A) revealed its dependence on the annealing temperature.

Keywords: Mg-Sr-Mn-nanoferrites; Phase transformation; Structural, Magnetic properties.

149

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ZnO thin films prepared by spray Pyrolysis

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Abstract

Zinc oxide (ZnO) is promising as an inexpensive transparent conducting oxide with low resistivity and high optical transmittance. ZnO is a semiconductor material whose bandgap can be tuned, which in turn finds various optical applications. there is II-VI group semiconductor material whose film is deposited on Glass substrate using aq. $ZnCl_2$ as a precursor. This study has been realised to establish the influence of the principal process variables governing the spray pyrolysis deposition of ZnO thin films on their electrical and optical properties as pertaining to photovoltaic applications. It shows that the temperature at which optimum ZnO thin films can be deposited by spray pyrolysis using a given set of conditions of solute concentration and carrier gas flow-rate cannot be assumed to remain unchanged for other deposition conditions. The study also shows that it is possible to find the necessary deposition conditions for producing optimum films. XRD analysis is done for structural analysis. these last analysis shows polycrystalline nature of samples with pure phase formation. Resistance measurement as a function of temperature is done for ZnO thin films. Semiconducting behaviour for ZnO is observed, which is in agreement with observed results.

Keywords: ZnO, thin films; solar cells, spray pyrolysis, optical transmittance, photovoltaic.

Effect of [Ga] / [Ga] + [In] Molar Ratio on Structural, Optical, and Electrical Properties of Electrodeposited CIGS Thin Films

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Abstract

Thin- films of CIGS photo absorber were deposited from the stoichiometric polycrystalline precursor onto glass/ITO substrates by the electrodeposition technique. The chalcopyrite structures of obtained films of CIGS were confirmed by the XRD spectroscopy. The effect of the [Ga] / [Ga] +[In] molar ratio in the precursor solution on the structural, chemical stoichiometry, and morphological properties of prepared samples, as well as the electrochemical behavior of the CIGS/electrolyte interface was investigated. The annealed CIGS films have a p-type of conductivity with the free carriers' concentration in the range of 10^{15}– $10^{16}cm^{-3}$ were determined by the change in the Mott–Schottky plots. An electrical equivalent circuit consisting of constant phase elements was used for modeling of the impedance spectroscopy measurements.

Keywords: CIGS, single electrodepostion, impedance spectroscopy**.**

151

Transparent Conductive Electrode PVK/Ag/PVK as Anode in Solar Cells

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Abstract

Organic solar cells have low efficiency.The optimization of solar cells takes into account the electrodes. Electrodes means which charge carriers are collected. Indium-tin-oxide (ITO) is used as anode. Therefore, indium component is rare, expensive, and has good transparency and conductivity.An alternative component, PVK / Ag / PVK is investigated in anode. The deposition on glass substrate shows 3.2 ohms of conductivity and 72.45% of transparency. In this work, we develop a transparent conductive oxide (TCO) without indium, which structure is D / M / D: dielectric / metal / dielectric or PVK / Ag / PVK on flexible substrate (PET).

Keywords: Indium, tin, dielectric, electrode.

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A Two-Step Approach for Electrochemical Deposition of Cu–Zn–Sn and Se Precursors for CZTSe Solar Cells

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Abstract

Cu_2ZnSnS_4 thin films have been successfully prepared by a novel synthesis process that involves two steps deposition of Cu_2ZnSnS_4 followed by a vacuum post-annealing treatment 350-550 °C for 30 mn. The structure and morphology of the CZTSe thin films were characterized using X-ray diffraction (XRD), scanning electron microscopy (SEM), and energy dispersive X-ray spectroscopy (EDS).
X-ray diffraction data indicates that the annealed thin films thin films have a kesterite -Cu_2ZnSnS_4 structure with preferred (112) orientation. The experimental conditions allowing the deposition of uniform and compact topographies with direct bandgap energy of the films is about 1.55 eV are determined. It is shown that Cu-poor and Zn-rich thin films are obtained depending particularly on applied potential.

Keywords: Cu_2ZnSnS_4 thin films, Electrodeposition, Solar cell, Semiconductor, kesterite,

152

Fabrication and Characterization of Porous TiO2/Nb2O5 Composite Film Photoelectrodes for Application in Dye-Sensitized Solar Cells

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Abstract

Porous and nanocrystalline composite films were deposited by electrophoretic deposition technique (EPD) from nanoparticles of titanium dioxide (TiO_2) and niobium (v) oxide (Nb_2O_5). The TiO_2/Nb_2O_5 composites photoanodes were fabricated to exploit the advantages of Nb_2O_5 like its high electron transport rate, higher stability and higher conduction band energy than TiO_2. These hybrid photoelectrode (photoanode) composed of TiO_2 and Nb_2O_5 were fabricated on a FTO coated glass substrate using electrophoretic deposition (EPD) technique. The colloidal suspension utilized in EPD cell consisted of mixture of TiO_2 and Nb_2O_5 nanopowders and 2-propanol in a Pyrex glass. The optimization of process-related EPD parameters yielded particle concentration of 0.25g/L, applied voltage of 35V, and deposition time of 90s. XRD graphs showed both Nb_2O_5 and TiO_2 nanoparticles present in the composite films in the ratio 1 to 1.78 which confirmed both type of nanoparticles deposited on the EPD cathode upon application of an electric field. The SEM micrographs of the composite electrode thin films showed that porous films of high quality with well controlled morphology were deposited using the EPD technique. Cells fabricated with optimum EPD parameters yielded a V_{OC} = 0.79V, J_{SC}=10.96mA/cm^2, FF=0.538, and η =4.7%. Conversion efficiency in composite based dye-sensitized solar cells increased slightly compared to values obtained in cells based on single material. The formation of core-shell structures and thus energy barrier is proposed to explain the improvement in solar cell efficiency.

153

Keywords: Titanium dioxide (TiO_2), niobium (v) oxide (N_2O_5), electrophoretic deposition (EPD), dye-sensitized solar cells (DSSC)

SURFACE PLASON RESONANCE Pour LES CELLULES photovoltaïqueS du ZnO

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Abstract

Les plasmons de surface de la couche d'Au déposée par pulvérisation sur un prisme en verre, sont excités optiquement. L'onde évanescente générée a l'interface sert ensuite à la conversion dans la couche de ZnO déposée sur l'Au, cette onde longitudinale se propage a l'interface et permet d'augmenter le rendement photovoltaïque par le fait qu'elle reste a l'interface.

Les résultats expérimentaux sont interprétés avec succès, car ils montrent qu'on peut augmenter le rendement de conversion en réalisant des oscillations collectives et localisées grâce à une onde optique. Ces résultats observés peuvent avoir des applications de grande efficacité, notamment pour les cellules solaires en silicium. Lorsqu'un photon provenant du soleil rentre en contact avec une cellule photovoltaïque, il existe une certaine probabilité pour que celui-ci soit absorbé par un atome d'une couche semi-conductrice expulsant un électron de l'atome et laissant derrière un "trou." Les électrons expulsés sont alors dirigés vers une électrode alors que les "trous", se comportant pratiquement comme une charge positive, se dirigent vers une seconde électrode.

La figure montre les réponses SPR du système Au / verre/ ZnO , puis ZnO dope a 2% d'Al et Zno dope a 6% d'Al., les minimums de réflectivité θ spr des différent systèmes Verre/Au/ZnO et ZnO:Al de 50 nm d'épaisseur, nous illustrons également que la (largeur à mi-hauteur) est plus grand de ZnO non dopé que dopé, la modification de la forme de la courbe SPR est principalement déterminée par les effets de rugosité de surface et particulièrement la variation de la partie imaginaire de la constant diélectrique du film,

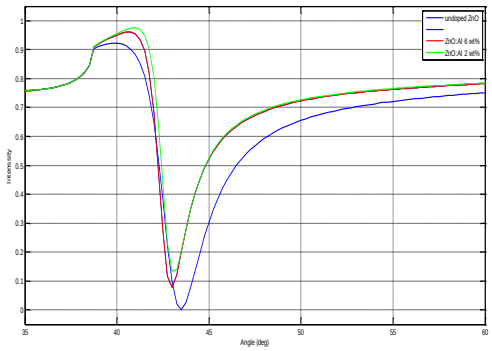


Figure: Courbes de réflectivité des systems Verre/Au/ZnO, Verre/Au/ZnO-Al(2%), et Verre/Au/ZnO-Al(6%).

Keywords: Conversion photovoltaique, surface Plasmon, rendement energetique

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Effect of Acetic Acid on ZnO:In Transparent Conductive Oxide Prepared by Spray Pyrolysis

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Abstract

The most prominent advantage of ZnO is that it is a II–VI semiconductor with a wide and direct band gap of about 3.37 eV at room temperature and a high binding energy of 60 meV. ZnO films have been extensively investigated either as a transparent conductive oxide or as a semiconductor for solar cells and electronic applications due to its features such as high electrical conductivity, optical transparency, easy preparation, and high stability in hydrogen plasma. Sputtering and Metal Organic Chemical Vapor Deposition (MOCVD) are commonly utilized to prepare ZnO thin films. However, the cost is relativity high. Spray pyrolysis (SP) has received extra attentions because of its simplicity, suitability for product industrialization, and low-cost. Utilizing SP to prepare ZnO/TCO has more potential than it is commonly recognized. Doping with indium can improve the electrical properties of sprayed ZnO thin films. In addition, substrate temperature, annealing and the pH of precursor solution have important influences on electrical, structural and optical properties of ZnO thin films. The acetic acid was commonly utilized to avoid the precipitation of Zn–OH species and change the pH of precursor solution.

In this work, undoped and indium doped zinc oxide (ZnO) transparent conductive oxide were prepared by a low-cost Spray Pyrolysis. The influence of acetic acid on properties of the ZnO thin films was investigated. The complex formed by [CH3COO−] and [Zn2+] in precursor solution was better for the growth of ZnO film. The acetic acid added in precursor solution can supply [CH3COO−] for both [Zn2+] and [In3+] to form complexes. That made the [Zn2+] and [In3+] have similar statement, which can promote the indium doping in the ZnO films. The surface morphology, structural and electrical properties of the ZnO thin films were influenced by the acetic acid adding. The total transmittance of the ZnO thin films is above 80% in the wide wavelength region from 400 nm to 2500 nm.

Keywords: ZnO; spray pyrolysis; acetic acid; indium doped; transparent conductive oxide.

Silicon Silver Layered Structure For Energy Harvesting Applications

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Abstract

Nowadays, hybrid silicon / plasmonic solar cells have been considered as economic viable alternative energy solution. The combination between the silicon and the plasmonic nanostructures such as silver and gold offers excellent light trapping and enhances the light absorption harvesting efficiency [1]. In this study, novel design of hybrid silicon /silver plasmonic solar cell has been proposed and analysed using 2D Finite difference time domain (FDTD) method [2]. The proposed solar cell is composed of Indium tin oxide (ITO) / silicon / silver combination as shown in Fig.1. Further, It can be shown from the figure that the silver layer comprises periodic patterns of silicon dioxide triangular defects and Indium nano-rods. The simulation mythologies are based on calculating the silicon absorption spectrum, A(λ) and then estimating the ultimate efficiency based on the following relation [1]:

$$\eta_{Abs}^{Si} = \frac{1}{1100} \frac{\int_{300}^{1100} \lambda \times I(\lambda) \times A(\lambda) d\lambda}{\int_{300}^{4000} I(\lambda) d\lambda} \quad (1)$$

where I(λ) is the photon flux density in the AM1.5G solar cell spectrum. In addition, A(***λ***) is the optical absorption of the active material silicon and λ is the wavelength. Based on our simulation results shown in Fig. 2, the suggested design with tunned dimensions achieves broad band absorption and shows an improvement in the power conversion efficiency over 500 nm thick bulk silicon material by about 258%.

156

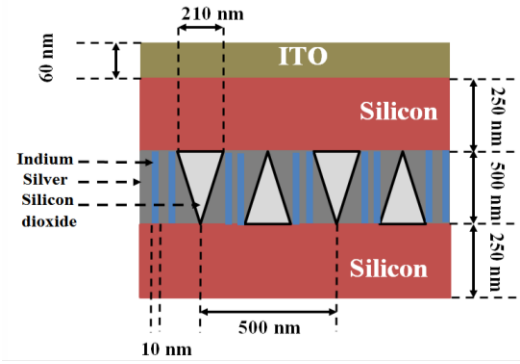


Figure 3. Proposed design, ITO-Si-Ag-Si

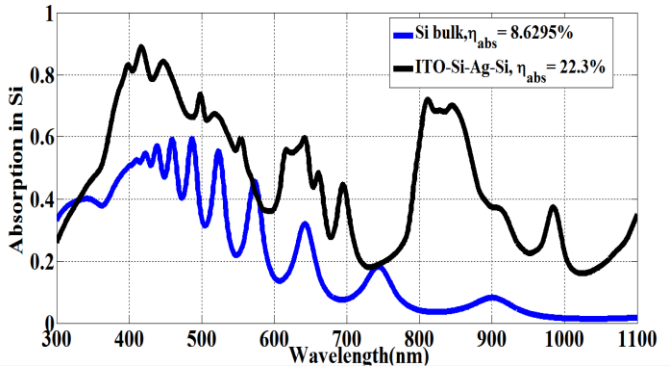


Figure 2. The absorption spectra

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Temperature dependence of H-aggregate emission and spectral diffusion in AnE-PVstat thin film

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Abstract

Conjugated polymers are very promising active materials for low cost, ease of production and large -area optoelectronic devices such as organic light emitting diode (OLED) [1] and organic photovoltaic cells (OPV) [2]. In those optoelectronic devices, the active layers are often prepared by spin coating or vapor phase deposition technique. This reduces the cost of production but gives rise to disorder effects. Due to the disorder of the polymer chains in thin film which can adopt many different conformation and spatial arrangement such as aggregation, excitons diffuse by hopping from one site to the next thereby relaxing energetically[3]. If σ caracterises the width of the Gaussian distribution of the density of state (DOS) then the thermal equilibrium energy is at $\Delta\varepsilon = -\frac{\sigma^2}{kT}$.

157

In an endeavor to correlate the spectral diffusion in conjugated polymer films, which is one of the physical phenomena that governs the performance of optoelectronic devices, with the morphology and the arrangement of polymer chains, we have employed the photoluminescence (PL) of a statistical copolymer poly-(p-aryleneethynylene)-alt-poly (p-arylene-vinylene)s (AnE-PVstat) thin film within a temperature range between 10 K and 300 K.

The temperature dependence of the ratio of the 0-0 to 0-1 peak intensity reveals an H- aggregate type[4]. We used a modified Franck Condon progression with a variable 0-0 peak intensity to reproduce the experimental PL spectra. From the fit we have extracted the electronic transition energy E_0 and the disorder parameter σ . We have plotted the spectral shift $\Delta\varepsilon$ normalised to the Gaussian line width σ versus $\frac{kT}{\sigma}$. Compared to the theoretical dependence $\frac{\Delta\varepsilon(T)}{\sigma(T)} = -\frac{\sigma(T)}{kT}$, we see a good agreement between theory and experimental data for $\frac{kT}{\sigma} > 0.2$ at high temperature. At low temperature $\frac{\Delta\varepsilon}{\sigma}$ saturates at -4.3.

Keywords: conjugated polymer, photoluminescence, H-aggregates, spectral diffusion.

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Optical Absorption Enhancement in Thin Film Solar Cell using Asymmetric Grating Structures

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Abstract

In this paper, a novel design of highly efficient modified grating crystalline silicon (c-Si) thin film solar cell is investigated and analyzed using 2D finite element method. The suggested grating is based on double-sided pyramid structure. The incorporation of the modified grating in the thin film solar cell offers a promising route to harvest light into the few micrometers active layer. A layer of silicon nitride is used as an antireflection coating (ARC). Additionally, the light trapping through the suggested design is significantly enhanced by the asymmetry of the top and bottom pyramids. The effects of the active layer height, and facet angle of the pyramid on the spectral absorption, ultimate efficiency (η), and short circuit current density (J_{sc}) are investigated. The numerical results show that 87.9 % efficiency improvement is achieved over the corresponding conventional thin film c-Si solar cell without gratings. Additionally, short circuit current J_{sc} of 27.73 mA/cm^2 is obtained.

Keywords: Solar cell, thin film, ultimate efficiency effeincy, gratting

158

Modelling of the Power Output of a PV Module Under Outdoor Conditions

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Abstract

In hot climates, such as the northern African climate, where the ambient temperature is usually higher than the optimal Photovoltaic operating temperatures most of the times during the year, the efficiency of the PV is significantly affected as it drops with the increase in temperature. Several studies suggested different correlations to estimate the power output and the cell efficiency in relation to the outdoor conditions in different environments; usually including parameters such as the ambient and cell temperatures, total incident radiation, other meteorological parameters, material and system-related properties such as transmittance of the glazing cover. This report studies different correlation of estimating the power output and efficiency based on the cell's operating temperature discussed in previous literatures while including wind speed and incident radiation to recommend a suitable correlation for the weather conditions in Cairo, Egypt.

Keywords: Si Photovoltaic, IV characteristics, Modelling, Cell temperature and efficiency.

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Exciton Diffusion Lengths of Polymer Measured by Forster Theory

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Abstract

In nowadays technology is not possible without optoelectronic devices based on conjugated molecules and polymers such as light-emitting diodes (OLEDs), transistors and organic photovoltaic cells (OPVs). The high conversion efficiencies are the result of efficient absorption of light and charge generation inside the devices, so the ability to engineer excitonic transfer processes has played an important role in realizing this high efficiency. For example, the accurate determination of the exciton diffusion length **(LD)** and diffusivity (**D)** is important in optimizing the design of OLEDs.

In fact there are most notable of techniques that have been used to extract these fundamental electronic parameters. In this work we use Forster theory to measure the exciton diffusion length of a polymer containing anthracene and poly (p-phenylene-ethynylene)-alt-poly-(p-phenylene-vinylene) (PPE-PPV) resulted in a chain based statistical copolymer, denoted **AnE − PVstat**. Where we found the diffusion length (LD) in donor-acceptor distance function (d) for each of the polymers in solution: AnE-PV*ab* / AnE-PV*ba*/ AnE-PV*stat* /AnE-PV*bb*.

This work quantifies the significance of energy transfer in OPV active materials through theoretical techniques.

160

Keywords: conjugated polymers, diffusion length, organic photovoltaic cells and Forster theory.

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Plasmonic Effect of Metallic Nanoparticles in Organic Solar Cells

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Abstract

Over the past decade, we have witnessed rapid advances in the development of organic photovoltaic devices (OPVs). At present, the highest level of efficiency has been surpassed 10% [1], suggesting that OPVs have great potential to become competitive with other thin-film solar technologies. Improving light trapping, due to the embedding of metallic nanoparticles, has been shown to be beneficial for a better photoabsorption in organic solar cells. Studies in plasmonics and in the organic photovoltaics fields are have been to improve the absorption of sunlight and the photon–electron coupling to boost the performance of the devices. Recently, introducing metallic nanoparticles (NPs) into organic solar cells is emerging as a potential method for highly improved light harvesting by utilizing their localized surface plasmonic resonance (LSPR) effect [2]. The different types of metallic NPs (sizes, shapes, and hybrids), incorporation positions, and NPs with tunable resonance wavelengths toward broadband enhancement are systematically summarized to give a guideline for the realization of highly efficient plasmonic photovoltaics. This review article presents a summary of organic photovoltaics, a description of the physical mechanisms of light trapping in organic solar cells through metallic nanoparticles and recent results on the incorporation of gold and silver nanoparticles to improve the efficiency of the plasmonic organic photovoltaics cells [3].

Keywords: organic solar cell, metallic nanoparticles, plasmonic effect, enhanced light absorption.

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Ex-Situ synthesized CuI in PVA Polymer Stabilized with TMED ligand and optimized with NaI salt

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Abstract

With an eye on improving its optical and electrical properties, copper iodide is ex-situ synthesized and embedded in the PVA polymer with a final content of 10 wt% CuI/PVA to form a polymer nano-composite. A tetramethylethylenediamine (TMED) is used as ligand to stabilize the CuI particles in the polymer matrix and to enable better dispersion. Sodium iodide (NaI) is used as a modifier and added to the matrix in the expenses of the CuI. The system shows two order of magnitude increases in the electrical conductivity and a lowest optical band gap is recorded at 2 wt. % of NaI added in expenses to CuI.

Keywords: polymer nanocomposite, PVA Polymer, optical spectroscopy

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162

Characterization of the Nd1-xSrxFe1-yCoyO3-δ Perovskite Oxides As Cathode Materials for Intermediate Temperature Solid Oxide Fuel Cells

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Abstract

One of the most important tasks in SOFC research is the reduction of the operation temperature 900° or 1000°C to about 700°C for future applications. This requires new materials, especially materials with increased electrocatalytic activity. These cathode materials should be characterized by increased oxide ion transport in addition to high electronic conductivity. Many investigations have been performed to improve the perovskite-type materials such as mixed ionic electronic conductor (MIEC) oxides. MIEC oxides have many potential applications, separation membranes for high-purity oxygen production, electrodes in fuel cells and batteries mainly due their higher ionic and electronic conductivity. In the present work, the oxides of Nd1-xSrxFe1-yCoyO3-δ (NSFC) series have been extensively studied for such applications. The properties of the NSCF compounds can be tailored by varying the Nd:Sr and Fe:Co ratios.

Perovskite-type oxides of Nd1-xSrxFe1-yCoyO3-δ with 0.0≤x≤1.0 and 0.0≤y≤1.0 have been prepared by glycerol nitrate technology and characterized by X-ray diffraction, thermogravimetric analysis and dilatometry. The XRD patterns of the Nd1-xSrxFe1-yCoyO3-δ solid solutions with 0.0≤x≤0.6 and 0.0≤y≤1.0 could be indexed in orthorhombic symmetry (sp. gr. Pbnm). Like in the case of Nd1-xSrxFeO3-δ, the O-orthorhombic – O/-orthorhombic transition is due to removing the cooperative Jahn-Teller distortion. The orthorhombic distortion of the perovskite structure of Nd1-xSrxFe1-yCoyO3-δ decreases with increasing strontium content, and the solid solutions with 0.7≤x≤1.0 and 0.0≤y≤1.0 have a nearly ideal cubic structure (sp. gr. Pm3m). The structural parameters were refined using Rietveld full-profile analysis. The introduction of cobalt into the iron sublattice leads to a gradual decrease of the unit cell parameters and volume.

163

The oxygen content for Nd1-xSrxFe1-yCoyO3-δ with 0.3≤x≤0.7 and 0.0≤y≤1.0 at 298-1373 K in air decreases with increasing of strontium and cobalt content. Such behavior can be explained by the fact that strontium and cobalt is act as the acceptor of electrons (Sr/Nd and Co/Fe). The negative charged acceptor defects in the oxide are balanced by the corresponding amount of positively charged oxygen vacancies and/or electron holes.

The substitution of strontium for neodymium sites results in an increase of relative linear expansion for Nd1-xSrxFe0.7Co0.3O3-δ (x=0.3; 0.4; 0.5 and 0.7). The average thermal expansion coefficients are 16.5×10-6 K-1 for x=0.3 and 25.1×10-6 K-1 for x=0.7 at 298–1273 K at atmospheric oxygen pressure.
The projection of isobaric-isothermal phase diagram for the Nd-Sr-Fe-Co-O system was presented.

Keywords: perovskite, cathode materials, solid oxide fuel cells

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Evidence of a Continuous Trap Distribution in the Alpha-Alumina D' Peaks

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Abstract

The Thermally phenomena is a study tool and characterization of electrical defects in solids.The existence of the thermoluminescent (TL) during thermal heating of a solid excited previously, is an evidence of the existence of trapping levels [1].
The originality of this study is to provide various extensions to the simple model, they concern the definition of traps levels that can be characterized by a continuous distribution. This model is applied to the peak D 'of an alumina single crystal -alpha [2].
The modeling results in equations to determine the concentrations of charge carriers upon which the expression of the TL intensity. An estimate of solutions using a digital calculation process has been considered. This approach requires the evaluation of certain parameters, E: deep trap, α: detrapping coefficient β: trapping coefficient γ: coefficient of recombination, EΔ: the height between the trapping levels and M: electron concentration trapped in snares (traps) disconnectés heat.
The theoretical curves are numerically analyzed using the Gaussian distribution and then we proceed to comparison adjustments from the corresponding models for different numbers of levels. The results clearly show that the incorporation of the continuous distribution of traps gives better quality adjustments; particularly in the case of the model has two trapping levels.

Keywords: alpha alumina, thermoluminescence, continuous trap distribution, Gaussian distribution, pic dosimetric modeling

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A Theoretical Study of Structural, Electronic and Stabilities Properties of PbX (X= Si, Ge and Sn)

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Abstract

An investigation on structural, electronic and stabilities properties of PbX (X=Si, Ge and Sn) in the zinc-blende structure has been conducted using first principles calculations (ab initio) based on density functional theory (DFT). For the structural, electronic, mechanical and thermodynamic properties we have used the full potential linear augmented plane-wave (FP-LAPW) method as implemented in the WIEN2K code [1]. To calculate the dynamical properties we have used plane wave pseudopotential (PW-PP) methods as implemented in the ESPRESSO code [2]. The exchange and correlation effects were treated using the generalized gradient approximation (GGA) [3] fully relativistic approximation is used for core electrons, and scalar relativistic approximation is used for valence electrons. Spin-orbit coupling is included. The calculated lattice constants are in good agreement with the available experimental results and the previous theoretical works. The band types and other properties for all materials are correctly estimated. All binary alloys predicted to be stable mechanically and unstable dynamically with respect to their elemental components at zero pressure and temperature.

Keywords: DFT, Electronic properties, Mechanical properties, Dynamical properties, Thermodynamic properties

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Broadband Absorption enhancement in a hybrid diamond-silicon nanowire arrays for photovoltaics applications

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Abstract

Thin film solar cells have potential advantages such as reduction in the amount of the active materials and efficient photogenerated carrier. Light trapping techniques play a significant role in reducing the thickness of the absorption layer without losing the efficiency. Several light trapping techniques have been used such as nanowires (NWs), nanoholes (NHs), nanopyramids, and nanocones to increase the solar cell efficiency. Several researchers have proposed different array arrangements to enhance the absorption efficiency. The tunability of the optical properties of SiNW arrays can also be adjusted by the nanowire diameter or lattice constant. In the current study, a new design of hybrid silicon-diamond nanowire is introduced and analyzed for solar cell applications. The optical properties are numerically investigated using 3D finite difference time domain method. The proposed design consists of vertical cylindrical SiNWs in the base and Si diamond in the top. To evaluate the light absorption capability of the proposed design, the ultimate efficiency is calculated. Therefore, the structural geometrical parameters of NWA are varied and optimized to maximize the ultimate efficiency. The numerical simulations are carried out within the wavelength range from 300 nm to 1100 nm. The proposed SiNW design shows high efficiency of 33.94 %, and short circuit current of 27.775 mA/cm^2 which exceeds that of cylindrical silicon nanowire with the same falling ratio by 22.19 %.

Keywords: Light trapping, Ultimated efficiency, Silicon nanowire.

An Approach to Constructing Permanently Porous Platforms of Ruthenium-tris(2,2`-bipyridyl) with Controllable Surface Areas and Backbone Functionality

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Abstract

The pressing world energy demands have put the DSSCs technology among others at the center of cutting edge research topics. Mimicking the Mother Nature, their active ingredient is an organic dye, usually equipped with a metal (e.g. Ruthenium) as its chromophore. Current technology incorporates the dye as a monolayer over nanocrystalline TiO2 electrodes, which isn't the best solution to capture light energy effectively. Here we introduce a new method for incorporating the dye as nucleoli to permanently porous polymers that serve its purpose more efficiently.

Keywords: Photosensitizers, DSSC, porous polymers, photocatalysis

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Passivated Silicon Wafer Carriers Lifetime Enhancement by Annealing for Solar Cells Applications

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Abstract

Silicon oxide films thermally grown at very high temperatures (>900°C) are generally used as a passivation layer in solar cells to suppress the surface recombination velocities (SRVs). Atomic layer deposited (ALD) thin layers of Al_2O_3 on a silicon wafer, offers a good alternative for SiO_2 with a passivation quality comparable to that of SiO_2. In addition, Al_2O_3 can be prepared by atomic layer deposition at low temperatures (<300 °C). We measure the minority carriers' life time of a p-type and an n-type silicon wafer passivated with 10 nm Al_2O_3 by quasi-Steady State Photo Conductance (QSSPC) method. The effect of annealing in ambient at different temperatures (200, 300,400, and 500 °C) on the carriers' life time was also investigated.
It was found that Al_2O_3 offers a better passivation for the p-type than the n-type as depicted in Figure 1. Minority carrier lifetime enhancement from 11.18 to 158.78 µs was achieved by annealing passivated p-type wafer at an optimum temperature of 300 °C. We ascribe the improved performance of p-type silicon above the n-type silicon to the field effect passivation phenomena.

168

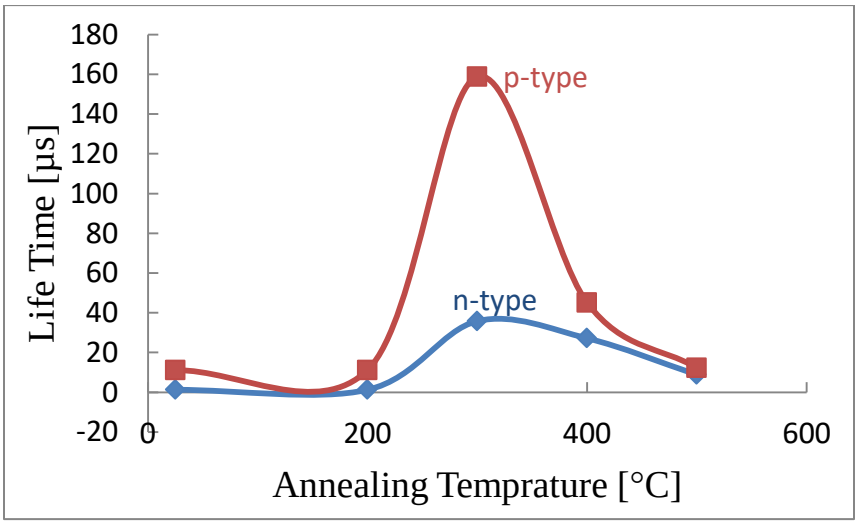


Figure 4: measured minority carrier lifetime of p-type and n-type wafers passivated by 10nm thin Al2O3 film versus annealing temperature. The lifetime was measured by QSSPC at room temperature.

Keywords: Thin film solar cells, Passivation, Al_2O_3 Passivation, Atomic layer deposition.

Synthesis and Optical Dispersion of Partially Reduced Graphene Oxide With Enhanced Photostability

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Abstract

Graphene (RGO) has been used to enhance conversion efficiency in dye-sensitized solar cell (DSSC) through increased electronic transportation. Partially reduced graphene oxide (prGO) were synthesized, then doped with polyvinyl alcohol (PVA). (prGO)/PVA composite films were prepared (with concentration: 0%, 0.25%, 0.5%, 0.8%, 1%, and 1.5% w/w), and characterized by X-ray diffraction (XRD) and (FTIR). The optical constants of (prGO)/PVA composite films have been investigated. Dispersion of refractive index (n) has been analyzed using the Wemple – Didomenico single oscillator model. The direct optical band gap is red shifted from 3.82 to 3.04 eV with the increase of (prGO) content. The absorption of (prGO) /PVA composite enhanced after irradiation by UV-visible light (solar simulator), which is more benefit in the solar cell applications.

Keywords: (PVA); (prGO); composite; optical properties; Photostability.