ANSOLE DAYS 2012

"Solar Energy for Sustainable Development"

17-19 February 2012

University of Yaounde I, Yaounde, Cameroon



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Daniel Ayuk Mbi Egbe

Jean- Marie Bienvenu Ndjaka

George Elambo Nkeng

César Kapseu

SUPPORTER OF

2012 INTERNATIONAL YEAR OF SUSTAINABLE ENERGY FOR ALL

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We acknowledge the practical and financial support of:

Elizabeth von Hauff (Uni-Freiburg, Germany), Harald Hoppe (TU-Ilmenau)

ANSOLE DAYS 2012 (17-19 February 2012)

"Solar Energy for Sustainable Development"

Venue: *Room S01/02 of the Pedagogic Block. University of Yaounde 1, Yaounde Cameroon*

Program

	Thursday 16.2.2012
14.00-18.00	**Registration**
	Friday, 17.2.2012
8.00-9.00	**Registration**
9.00-10.00	**Opening ceremony** **moderated by Prof. Dr. Jean Marie Ndjaka**
	Section A: Chemistry and Physics of Organic Solar Cells
	Chairman: Samir Romdhane
10.00-10.40	*Keynote Lecture 1* ***Material design for organic solar cells***, Daniel A. M. Egbe, Johannes Kepler University Linz, Austria
10.40-11.00	**Coffee Break**
11.00-11.40	*Keynote Lecture 2* ***Issues related to efficiency and stability in polymer based solar cells,*** Elizabeth von Hauff, University of Freiburg, Germany
11.40-12.00	**O1*: Dye-sensitized solar cell using natural dyes extracted from jiwene (acalypha wilkesiana) stem,*** Adenike Boyo O, Shitta , M.B.O, Oluwa K.O, Adeola O, Lagos State University, Ojo, Badagry Nigeria/ Federal university of Ado Ekiti, Osun, Nigeria
12.00-12.40	*Keynote Lecture 3* ***Imaging methods for quality control and degradation analysis of organic solar cells,*** Harald Hoppe, Gerhard Gobsch, Marco Seeland, Roland Rösch, Burhan Muhsin, Maik Bärenklau, Ilmenau University of Technology, Ilmenau, Germany
12.40-13.00	**CP1:** ***Matrix Power, Douala Cameroun,*** Serge Henri Kelbe
13.00-14.00	**Lunch Break**
	Section B: Modelling and Design of Solar Systems
	Chairman: Harald Hoppe
14.00-14.40	*Keynote lecture*:4 ***Computer simulation of structural and optical properties of a dye sensitized solar cell,*** Ralph Gebauer, The Abdus Salam International Centre for Theoretical Physics, Trieste, Italy
14.40-15.00	**O2:** ***Modelling with shrinkage of the Indirect solar drying kinetics of sheanut (Vitellaria Paradoxa Gaertn.) kernels,*** Divine Nde Pub, Charles Fon Abi, Dzudie Tenin, César Kapseu, Clergé Tchiengang, Zéphirin Mouloungui, Higher Institute of the Sahel, University of Maroua, Cameroon/ ENS, University of Yaounde 1, Cameroon/ ENSAI, University of Ngaoundere, Cameroon/ Université de Toulouse, France.
15.00-15.20	**O3**: ***Structural properties of CdS_xTe_{1-x} under high pressure from ab initio calculations,*** A. Bouzid, Z. Rouabah, N. Bouarissa , University centre of Bordj Bou Arréridj, Algeria
15.20-15.40	**O4**: ***Electronic structure and optical properties of $Si_{1-x}Ge_x$,*** Z.Rouabah, A. Bouzid, N. Bouarissa, Centre Universitaire de Bordj-Bou-Arreridj, El-Anasser, Bordj-Bou-Arreridj, Algeria
15.40-16.00	**CP2:** ***DAAD information centre in Cameroon,*** Katja Buchecker, University of Yaounde

	1, Cameroon
16.00-16.20	**Coffee Break**
	Chairman: Ralph Gebauer
16.20-17.00	*Keynote Lecture 5:* ***Concentrating Solar Power Technologies,*** Bertrand.F. Tchanche, Université de Lorraine, Nancy, France
17.00-17.40	*Keynote lecture 6:* ***Solar cell quality control by both recombination and electrical parameters determination: Application to a vertical parallel multifunction silicon solar cell,*** George Sissoko, University Cheik Anta Diop of Dakar, Senegal
17.40-18.00	**O5*: Methodology to design a food stuffs solar drier*,** Yacoub I. Halawlaw, University of Djamena, Chad
18.00-20.00	***GENERAL ASSEMBLY OF ANSOLE***
	Saturday, 18.2.2012
	Section C: Physics of semiconducting solar cells
	Chairman: Martin Kamta
9.00-9.40	*Keynote lecture 7:* ***Charge transport in bulk-heterojunction solar cells,*** Nadia Camaioni, Consiglio Nazionale delle Ricerche, Bologna Italy
9.40-10.00	**O6*: Qualitative, Optical and Structural Characterization of Titanium Oxide Thin Film Prepared by sol-gel Dip coating Method*,** Aderemi B. Alabi, Babalola Olayinka A University of Ilorin, Ilorin, Nigeria
10.00-10.30	**Coffee Break**
10.30-11.00	**O7*: EXAFS study of thermal expansion in Cadmium Selenide compound*,** Bridinette Fandio, University de Yaoundé 1 and Université des Montagnes, Bangangté, Cameroon
11.00-11.20	**CP3: *The Photovoltaic-Cluster Solarvalley Mitteldeutschland – Innovation by Co-operation*** *Daniel A. M. Egbe, Peter Frey, Sabine Schmidt, Hubert Aulich* ANSOLE Germany e.V, Jena, Germany./ SolarValley Mitteldeutschland GmbH, Erfurt, Germany.
11.20-11.40	**CP4**: ***Yandalux GmbH, Hamburg Germany***, Alexander Sipua Ngnoubamdjum
11.40-12.00	**CP5: *Antaris Solar GmbH- Solair Afric Sarl, Yaounde Cameroon*** Noa Simeon
12.00-14.00	**Lunch Break**
	Section D: Solar Energy Technologies for Sustainable Development
	Chairman: Cesar Kapseu
14.00-14.40	*Keynote lecture 8:* ***The Solar Bottle and Solar Fountain: An educational tool for creating awareness of energy management,*** Mark Vervaart, CEA/INES R.D.I., Laboratory for Solar Systems (L2S), Le Bourget-du-lac, France
14.40-15.20	*Keynote Lecture 9:* ***Quantification of aerosol requirements for forecasts of electricity production by concentrating solar systems,*** Armel Oumbe, Total Gas & Power, R&D – Concentrated Solar Technologies, France
15.20-15.40	**O8: Rural Electrification in Cameroon -Lessons learned from 4 years of projects**, Paul Ngwe Mbeleg, Tobias Klaus,*International Solar Energy Research Center Konstanz e.V.,*

	Konstanz; Germany. Email
15.40-16.00	**O9:** ***Thermal efficiency and durability of Box Type Solar Cookers in India: An Experimental study,*** Rajkumar Sekaran, M. Rajesh Kumar, R. V. Jeba Rajasekhar, A. Sundaram, Tennyson Daniel, , Madurai Kamaraj University, India/, Government Arts College, Melur, India
16.00-16.20	**O10*: Investigation of the solar energy technology in South Africa,*** Silas K Mulaudzi, Mammo Muchie, Energy and Electricity Division, City of Tshwane, Pretoria, South Africa/ Tshwane University of Technology, Pretoria, South Africa
16.20-16.40	**O11:** ***Solar energy sustainability in Central Africa: Cameroon case study,*** Joseph Kenfack, Antoine Amie Assouh, Oumarou Hamandjoda, , Dieudonné Kidmo Kaga, , Blaise Biniom, Médard Fogue., National Advanced School of Engineering, Yaounde, Cameroon/University of Douala , Cameroon/ Electricity Sector Regulatory Agency (ARSEL) Yaounde, Cameroon/Institut du Supérieur du Sahel, University of Maroua Cameroon/IUT Bandjoun, Cameroon/University of Dschang, Cameroon
16.40-17.00	**Coffee Break**
	Posters Session
	Poster award committee: Mark Vervaart, Harald Hoppe, Nadia Camaioni, Elizabeth von Hauff
17.00-18.00	**P1.** ***Improvement of the yield of a photovoltaic systemby the approach based on the electrical load parameters,*** A. Dandoussou, M. Kamta, E. T. Houdji, B. Late, University of Ngaoundéré , Cameroon/University of Maroua, Cameroon **P2**. ***Mobility and Photovoltaic Performance Studies on Polymer Blends: Effects of Side Chains Volume Fraction.*** G. Adam, A. Pivrikas, A. Montaigne, S.Tadesse, T. Yohannes, N. S. Sariciftci, D. A. M. Egbe, Johannes Kepler University Linz, Austria. /University of Addis Ababa, Ethiopia. **P3**. ***Vanadium Dioxide based nanophotonics,*** A. Simo, R. Madjoe, J. M. B. Ndjaka, S. Zekeng, M. Maaza, Nanosciences African Network, Nanoscience Laboratories, Materials Research, Somerset West 7129, South Africa/ University of Yaounde 1/University of Western Cape, Belleville, South Africa. **P4. Experimental investigation of CPC with flat one-sided absorber: Energy and Exergy analyses,** C.V. Aloyem Kaze, R. Tchinda, E. Mbaka Nfah. University of Dschang, Cameroon/ IUT-FV Bandjoun, Cameroon. **P5.** ***Optical properties of catechol and Alizarin dye TiO_2 nanowires from time-dependent density functional theory,*** B. M'Passi-Mabiala, H.D. Douma, R. Gebauer *Université Marien* Ngouabi, Brazzaviile, Congo/UR-MATER, DGRST, Brazzaville, Congo/Centre de Physique atomique et d'Optique quantique, Douala, Cameroon/The Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy/ CNR-IOM DEMOCRITOS Simulation Center, Trieste, Italy. **P6**. ***Comparative study of power supply systems for Relay stations of***

telecommunications in the northern area of Cameroon: case of the photovoltaic system and the generator group, Bello P. Ngoussandou, University of Maroua, Cameroon.

P7. ***Thermomechanical characteristic Briquettes and chemical energy based plant household waste***, Y. Jiokap, I. Samonssa, K. Richard, University of Ngaoundéré, Cameroon.

P8. ***Transient study of silicon solar cell under pulsed electric excitation: Determination of recombination parameters,*** I. Zerbo, R. Sam, M. Zoungrana , A. D. Seré, A. T. Kam, F. Zougmoré, University of Ouagadougou, Burkina Faso/ Polytechnic University of Bobo Dioulasso, Burkina Faso

P9. ***Alimentation des sites isolés en Energie Solaire : cas des campements et des hôtels de tourisme au Cameroun,*** **C.** Kapseu, C. A. Koueni Toko, M. Kombi, A. Ahmed, Ecole Nationale Supérieure des Sciences Agro-industrielles, Université de Ngaoundéré - Cameroun / Ministère du Tourisme Yaoundé, Cameroun / Institut Universitaire de Technologie, Université de Ngaoundéré, Cameroun

P10. ***Software tool support for simulation of a photovoltaic system running on a hot and dry climate*****,** B.Laté, A. Dandoussou, M. Kamta, R. Tchinda**,** Université de Dschang, Dschang, Cameroun/Université de Ngaoundéré, Ngaoundéré, Cameroun.

P11. ***Thermal characterization of a sensor solar plane low temperature*****,** E. Mbou Tiaya, A. Kemajou, University of Douala, Cameroon

P12. Effect of moisture content of canarium fruit (*Canarium schweinfurthii) on texture pulp: Application to pulp dehydration* , G. B. Nkouam, C. Kapseu, D. Barth, M. Dirand, The Higher Institute of the Sahel, University of Maroua, Cameroon/, ENSAI-University of Ngaoundere, Cameroon/ UPR CNRS 3349 ENSIC-INPL, Nancy Cedex, France.

P13. ***Solar technologies for buildings*****,** N. Djongyang, R. Tchinda, C. Kapseu, Faculty of Science, University of Ngaoundere, Cameroon/IUT Fotso Victor, Bandjoun, Cameroon/ University of Dschang, Cameroon/ ENSAI, University of Ngaoundere, Cameroon

P14. ***Sesamum indicum L: A potential source for the production of biodiesel***, S. N. Nouadjep, C. Kapseu, E. Nso, University of Ngaoundere, Ngaoundere, Cameroon.

P15. ***Three dimensional approach of spectral response for polycrystalline vertical junction silicon solar cell***, G. Sissoko, Z. Nouhou Bako, Université Cheikh Anta Diop, Dakar, Sénégal/Université de Maradi, Niger.

P16. ***Biogas Production by co-digestion of banana peelings and Pig Manure*****,** E. J. Nso, D. C. Feudjio, C. Kapseu, Université de Ngaoundéré, Cameroun.

P17. ***Optical properties of MEH-PPV and MEH-PPV/ [6,6]-Phenyl C61-butyric Acid 3-ethylthiophene Ester thin films*****,** B. M. Omer, A. K. Mohamed, Omdurman Ahlia University, Omdurman, Sudan.

P18. ***Design, simulation and realization of an intelligent charge controller for***

	accumulators in renewable energy power stations, P. D. Dongo, C. T. Tchito, R. Tchitnga, A. R. Tchamda, J. T. Kewir, A. Fomethe, University of Dschang, Cameroon. **P19.** ***Renewable energy production from algae: Spirulina*****,** Y. Jiokap, P. Kouteu, C. Kapseu, University of Ngaoundéré, Cameroon. **P20.** ***Determination of criteria for the choice of photovoltaic cells***, A. D. Pene, C. Kapseu, L. Bitjoka, G. E. Nkeng, D. A. M. Egbe, University of Ngaoundere, Cameroon/ Ecole Nationale Supérieure des Travaux Publics, Yaounde, Cameroon/ Johannes Kepler University Linz, Austria. **P21.** ***Correlation between emission spectrum and diffusion rate using Franck-Condon analysis in Solar Cell Polymers*****,** M. A. Saidani, Ö. Usluer, Z. Ben Hamed, A. Ben Fredj, F. Kouki, S. Romdhane, D. A.M. Egbe , H. Bouchriha, University of Tunis, Tunisia/ Johannes Kepler University Linz, Austria/ University of Bizerte, Tunisia **P22.** ***Eigen modes of a wind turbine wooden blade*****,** S. Touré, R. Kalou, B. Troh, University of Cocody, Abidjan, Côte d'Ivoire. **P23**. ***Synthesis of functional organic materials based on tetrafulvalene (TTF) for optoelectronic devices***, L. Boudiba, S. Boudiba, H. Douib, A. Gouasmia, University of Tebessa, Algeria **P24**. ***Reducing Energy Bills of Higher Education Institutions with Solar Energy.*** *César Kapseu ; Dr Noel Djongyang ; Teukam Dabou ; Tientcheu Maxwell ; Njukouyou Ibrahim ; Eyono Fabrice* . -Université de Ngaoundéré **P25.** ***Design of an Electronics Power and Charge Controller for Hybrid Energy Systems (EPCCHES),*** *André Rodrigue Tchamda, Robert Tchitnga, Christian Tchapga Tchito, Martin Kom , University of Dschang, Cameroon / Université de Yaoundé I, Cameroon*
19.00-22.00	**Conference Dinner** ***DAAD-sponsored cultural event: "No bills with the Sun"*** ***coordinated by Emelda Ngufor Samba***
	Sunday, 19.2.2012
	Section D: Solar Energy Technologies for Sustainable Development **Section E: Assessment of Promoting Factors for Solar Applications**
	Chairman: Bertrand Tchanche
8.30-9.00	*Keynote lecture 10:* ***Converting Research Results in Solar Energy into Innovation: Ideas and Experiments in Strengthening the African Solar Energy Network*****,** Mammo Muchie, Tshawne University of Technology, Pretoria, South Africa
9.00-9.40	*Keynote lecture 11:* ***Assessment of solar radiation over Africa: present and future*****,** Lucien Wald, MINES ParisTech, Centre Energétique et Procédés, Sophia Antipolis cedex, France
9.40-10.00	**O12:*****Estimating hourly global solar radiation from satellite images,*** N. E. Erusiafe Michael Chendo, University of Lagos, Akoka, Lagos Nigeria
10.00-10.20	**O13:*****The Status of Solar Photovoltaic and Solar Thermal Applications in Malawi*****,** Chifundo Tenthani, T. Senganimalunje ., E. Phiri, The Malawi Polytechnic, Blantyre, Malawi/ The University of Malawi, Zomba, Malawi.

10.20-10.40	**O14:** ***Design and preliminary test results of three wind turbine battery chargers in Côte d'Ivoire,*** Siaka Touré, Diakaridja Traoré, Laboratoire d'Energie Solaire Université de Cocody, Abidjan, Côte d'Ivoire
10.40-11.00	**O15:** ***Situation of renewable energies in the Central Africa region: the case of solar energy,*** Cesar Kapseu, Noël Djongyang , Mathurin Petsoko, University of Ngaoundéré, Cameroon
11.00-11.20	**Coffee Break**
	Chairman: Joseph Kenfack
11.20-11.40	**O16: Study of the relation between banks and producers of renewable energies goods**, Aliou Dewa Bassirou, University of Ngaoundere, Cameroon
11.40-12.00	**O17:** ***Sustainable energies for rural development in sub-shahara africa: Interdisciplinary approach and organisational challenge,*** Marthe Njuikom, Forum des Energies Renouvelables pour le Développement Durable et la Solidarité Internationale (FERDEDSI), KR Alkmaar, The Netherlands
12.00-12.20	**O18*****: Country experiences: Solar radiation climatology in Côte d'Ivoire Technique of implementing a station of solar radiation and meteoclimatic parameters measure for establishing a West African Solar Radiation Atlas,*** Yao N'Goran, Kouakou Konan Université de Cocody, Abidjan, Côte d'Ivoire/ *Institut National Polytechnique Félix Houphouet-Boigny (INP-HB), Yamoussoukro, Côte d'Ivoire,*
12.20-12.40	**O19*****: Solar drying of sludge,*** Thomas Nyanga, Université de Toulouse, France
12.40-13.00	**O20*****: Electricity storage for PV energy: technological evolutions in stand-alone and grid-connected systems,*** Mark Vervaart, Marion Perrin, CEA/INES R.D.I., Laboratory for Solar Systems (L2S) Le Bourget-du-lac, France
13.00-13.20	**O21:** ***Wind energy potential in Sahel,*** Saïdou Madougou, Frederique Said, Bernard Campistron, Université Abdou Moumouni de Niamey Niger/Université de Toulouse, France
13.20-14.00	**Closing Ceremony**
14.00-16.00	**DAAD-Alumni meeting**

KL1
Material Design for Organic Solar Cells

Daniel Ayuk Mbi Egbe
African Network for Solar Energy (ANSOLE)& Linz Institute for Organic SolarCells , Johannes Kepler University Linz, Altenbergerstr.69, 4040 Linz, Austria..daniel_ayuk_mbi.egbe@jku.at & daniel.egbe@ansole.org

Semiconducting organic materials have proven their potential for the design of organic photovoltaic (OPV) devices as low cost energy sources[1]. Intensive interdisciplinary research in this area is presently going on worldwide, which results in a rapid enhancement of the state-of-the-art power conversion efficiency, $\eta_{AM1.5}$. Certified $\eta_{AM1.5}$ values around 10 %have been reported[2]. First products based on OPV are now marketed [3]. The bulk heterojunction (BHJ) concept consisting of an intermixing of the donor and acceptor components in the active layer has proven to be the most efficient way to design high performance devices. The first part of this lecture presents the requirements to be fulfilled by efficient photoactive materials for OPV devices, and reports on general synthetic strategies for their design[4].The second part will deal with examples from our research. Our systematic approach on the study of effect of alkoxy side chains has led to the design of materials showing state –of- the art efficiencies for poly(*p*-phenylene-vinylene) (PPV) based materials [5,6].

[1].(a) Sariciftci, N. S.; Smilowitz, L.; Heeger, A. J.; Wudl, F. *Science* **1992**, *258*, 1474.(b) Günes, S.; Egbe, D. A. M.; Sariciftci, N. S. "**Polymer Solar Cells**" in ***Encyclopedia of Polymer Science and Technology*** **2011.**
[2].http://www.mitsubishichem-hd.co.jp
[3] http://www.neubers.de/Solar-Taschen
[4]Cheng, Y.-J.; Yang, S.-H.; Hsu, C.-S. *Chem. Rev.* **2009**, *109*, 5868.
[5] (a) Egbe, D. A. M.; Türk, S.; Rathgeber, S.; Kühnlenz, F.; Jadhav, R.; Wild, A.; Birckner, E.; Adam, G.; Pivrikas, A.; Cimrova, V.; Knör, G.; Sariciftci, N. S.; Hoppe, H. *Macromolecules* **2010**, *43*, 1261. (b) Egbe, D. A. M.; Adam, G.; Pivrikas, A.; Ramil, A. M.; Birckner, E.; Cimrova, V.; Hoppe, H.; Sariciftci, N. S. *J. Mater. Chem.* **2010**, *20*, 9726.

[6] (a) Egbe, D. A. M.; Neugebauer, H.; Sariciftci, N. S. *J. Mater. Chem.* **2011,** *21*, 1338. (b) Adam, G.; Pivrikas, A.; Ramil, A. M.; Tadesse, S.; Yohannes, T.; Sariciftci, N. S.; Egbe, D. A. M. *J. Mater. Chem.* **2011**, *21*, 2594. (b) Susarova, D. K.; Khakina, E. A.; Troshin, P. A.; Goryachev, A. E.; Sariciftci, N. S.; Razumov, V.; Egbe, D. A. M, *J. Mater. Chem*. **2011**, *21*, 2356. (c) Egbe, D. A. M.; Carbonnier, B.; Birckner, E.; Grummt, U.-W. *Prog. Polym. Sci.* **2009**, *34*, 1023.(d) Rathgeber, S.; Perlich, J.; Kühnlenz, F.; Türk, S.; Egbe, D. A. M.; Hoppe, H.; Gehrke, R**.** *Polymer* **2011**, *52*, 3819.

Acknowledgement: I am grateful to the Deutsche Forschungsgemeinschaft (DFG) for financial support in the framework of the priority program SPP1355.

KL2
Issues related to efficiency and stability in polymer based solar cells

Elizabeth von Hauff
[a] *Institute of Physics, Freiburg, Germany.*[b] *Fraunhofer Institute for Solar Energy Systems, Freiburg, Germany*
elizabeth.von.hauff@physik.uni-freiburg.de

Polymer-based photovoltaics presents an interesting possibility for low cost energy production. Conducting polymers are carbon-based materials which conduct electricity due to their unique electronic structure. These macromolecules can be synthesized with side chains to enhance their solublity, so that polymers can be processed into thin films from solution using a range of low cost, low temperature processing techniques. In the solar cell, the polymer is blended with a soluble fullerene derivative to form a donor-acceptor system for the absorption of light, the separation of the photogenerated electron-hole pairs, and transport of charges out of the cell as current. The solar cell performance depends on the complex properties of the polymer:fullerene active layer. In particular, conducting polymers demonstrate complex structure-function relationships, and conformation and ordering at the molecular scale and in the thin film have a great impact on solar cell performance. Understanding the correlation between the physical processes occurring at the different length scales, from polymer to solar cell, is crucial to improving

polymer-based photovoltaic performance. In this talk, strategies to improve solar cell performance are discussed [1,2]. In addition to efficiency, stability is a major parameter which influences the feasibility of polymer solar cells as a marketable technology. Novel materials and solar cell architectures to improve device stability are demonstrated [3,4].

[1] A. De Sio, T. Madena, R. Huber, J. Parisi, S. Neyshtadt, F. Deschler, E. Da Como, S. Esposito, and E. von Hauff, *Sol. Energ. Mat. Sol. C.* **2011**, *95*, 3536-3542.

[2] F. Deschler, E. Da Como, T. Limmer, R. Tautz, T. Godde, M. Bayer, E. von Hauff, S. Yilmaz, S. Allard, U. Scherf and J. Feldmann, *Phys. Rev. Lett.* **2011**, *107*, 127402.

[3] B. Ecker, J. Nolasco, J. Pallarés, L. Marsal, J. Posdorfer, J. Parisi, E. von Hauff, *Adv. Funct. Mat.* **2011,** *21*, 2705–2711.

[4] A. De Sio, K. Chakanga, O. Sergeev, K. von Maydell, J. Parisi, and E. von Hauff, *Sol. Energ. Mat. Sol. C. 2011*, in press.

O1

Dye-sensitized solar cells using natural dyes extracted from jiwene (acalypha wilkesiana) stem

BOYO , A.O,[a] * Shitta , M.B.O,[b] Oluwa K.O,[c] Adeola O[d]

[a]*Department of physics, Lagos state university, ojo, Badagry,Nigeria.*[b]*Department of physics, Federal university of Ado Ekiti, Osun, Nigeria.*[c]*Department of Botany, Lagos state university, ojo, Badagry, Nigeria.*[d]*Department of Biochemistry, Lagos state university, ojo, Badagry, Nigeria.** nikeboyo@yahoo.com

Dye-sensitized solar cells (DSSCs) were fabricated using natural dyes extracted from Jiwene (Acalypha wilkesiana) stem. The mode of extraction is soxhlet ethanol extraction. We observed that the cell sensitized by the Jiwene extract was in agreement with the broadest spectrum of the extract adsorbed on TiO_2 film. The energy conversion efficiency (η) of the cells is 0.05% and fill factor 0.83. The sensitization performance related to interaction between the dye and TiO_2 surface is discussed. The explanations are supported by the light absorption of the extract solution compared to extracts adsorbed on TiO_2 and also dye structures. The effects of changing extracting pH of the extract dye were discussed; pH of the dye was adjusted from 4.9 to 2.0. DSSC stability was also improved by the changes in conditions .A test of anthraquinones and flavonoids shows less anthraquinones and no flavonoids in the extract. However, the efficiency of a DSSC using ethanol as extracting solvent was found to be diminished after being exposed to the simulated sunlight for a short period.

KL3

Imaging Methods for Quality Control and Degradation Analysis of Organic Solar Cells

Harald Hoppe, Gerhard Gobsch, Marco Seeland, Roland Rösch, Burhan Muhsin, and Maik Bärenklau*
Institute of Physics and Institute of Micro and Nanotechnologies, Ilmenau University of Technology, D-98693 Ilmenau, Germany. harald.hoppe@tu-ilmenau.de

The application of several spectroscopic imaging methods, among which are luminescence imaging and lock-in thermography, for characterization of organic solar cells and modules is reported.
We show that a combination of several imaging methods yields the best discrimination of the entity that has been degraded. Furthermore, imaging provides a powerful tool to detect a number of processing deficiencies with the potential of inline integration.
An outlook is given on more quantitative approaches for an improved understanding of emission patterns

CP1

Matrix Power: Eau et Energie

Serge Henri Kelbe
Matrix Power, B.P. 7242 Douala Cameroon. Serge_hk@yahoo.fr

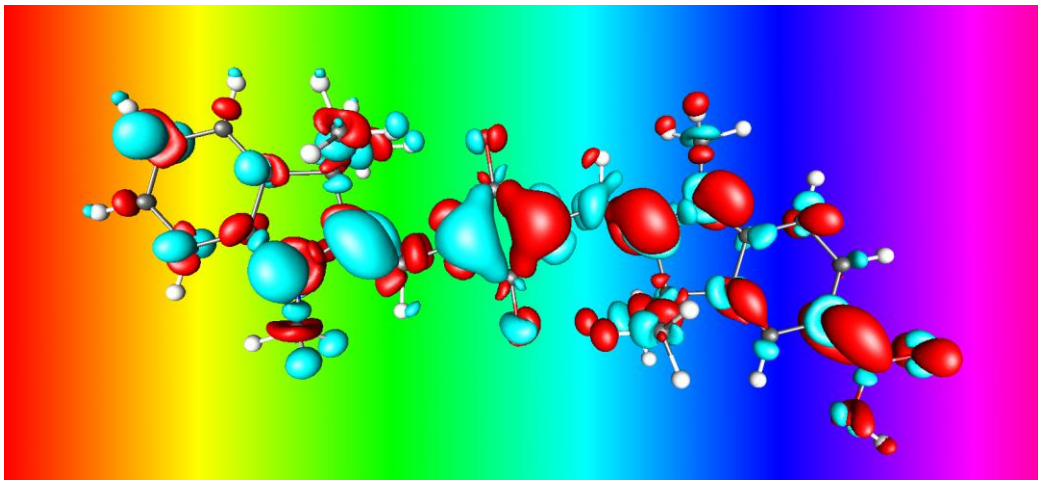
1- Présentation Serge Henri Kelbe
2- Présentation Matrix Power
3- Historique du photovoltaïque
4- Procédés d'obtention des cellules Photovoltaïque
5- Différentes applications du photovoltaïque
6- Exemple d'applications réalisées par Matrix Power
Cas du village de Botbadjan (Sanaga Maritime) et Allat (Adamaoua)
7- Perspectives du marché Camerounais
8- Fin et remerciement.

KL4

Computer simulation of structural and optical properties of a dye sensitized solar cell

Ralph Gebauer
The Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy.rgebauer@ictp.it

An organic dye sensitized solar cell consisting of a squaraine molecule attached to a TiO2 surface is modeled using first principles molecular dynamics and time-dependent density functional theory.The system is surrounded by solvent molecules which are treated at the same level of theory as the dye molecule and the surface. The effect of the solvent on the optical properties is investigated by computing many absorption spectra for various configurations along a molecular dynamics trajectory. It is shown that the dynamical effects induced by thermal fluctuations have a strong effect on the optical properties, and that a satisfactory agreement with experiments is only achieved if those thermal effects are accounted for explicitly.



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O2

Modelling with shrinkage of the Indirect solar drying kinetics of sheanut (Vitellaria Paradoxa Gaertn.**) kernels**

Divine Nde Bup [1,3*], *Charles Fon Abi*[2], *Dzudie Tenin*[3], *César Kapseu*[3], *Clergé Tchiegang*[4], *Zéphirin Mouloungui*[5]

[1] Higher Institute of the Sahel, University of Maroua, P.O. Box 45, Maroua, Cameroon.[2] Department of Chemistry, Advanced Teachers' Training College, University of Yaounde 1, PO Box 47, Yaounde, Cameroon. [3] Department of Process Engineering, ENSAI, University of Ngaoundere, P.O. Box 455 Ngaoundere, Cameroon.[4] Department of Food Science and Nutrition, ENSAI, University of Ngaoundere, P.O. Box 455 Ngaoundere, Cameroon. [5] Université de Toulouse – UMR 1010 - Laboratoire de Chimie Agro-Industrielle, ENSIACET, INP, INRA, 4 allée Emile Monso – BP 74233 – F-31432 Toulouse Cedex 4, France. *bupdiv@yahoo.fr

An indirect solar dryer was tested and uses under the environmental conditions of Ngaoundere to dry sheanut kernels. Shea butter, usually extracted from kernels of Vitellaria paradoxa Gaertn. by rural women in Sub-Saharran Africa, has multiple traditional and industrial uses. Three levels of the tray height form the solar heater 15, 30 and 45cm were tested when empty and when loaded. Four different airspeeds (natural convection, 0.6, 1 and 1.4 m/s) as well as the effect of particle size on the drying kinetics were investigated. The effect ofOptimum drying air parameters obtained in the dryer were airspeeds of 1 and 1.4 m/s and a temperature of 40-45 ^{o}C. Sheanut kernel slices dried entirely in the falling rate period and gave rise to only one drying constant for each treatment. The drying rate decreased with an increase in particle size. The effect of particle size on the drying rate as observed in this work, suggested that, the drying process was controlled by internal mass transfer. The drying kinetics was successfully modelled by the method of characteristic drying curve as well as with diffusive models. Effective moisture diffusivities of sheanut kernel slices calculated without shrinkage were greater than those calculated with the incorporation of shrinkage by a value of about 50%. Hence the calculation of effective moisture diffusivities without shrinkage overestimated its values. The acid and peroxide values of the butter indicated that butter from the dryer could be classified either as Category 1 or 2 butter irrespective of the drying conditions to which the kernels were subjected. Hence the indirect solar dryer could be used to produce butter with recommended properties for use in the cosmetic, pharmaceutical and in the food industry.
Keywords: Indirect solar drying, modelling, shrinkage, sheanut kernels

O3

Structural properties of CdS_xTe_{1-x} under high pressure from ab initio calculations

Abderrazak BOUZID[*], *Zahir ROUABAH and Nadir BOUARISSA*

Materials and Electronic Systems Laboratory, University center of Bordj Bou Arréridj, 34000, Algeria.
a_bouzid@hotmail.com

Structural properties of CdS, CdTe and their ternary mixed crystals CdS_xTe_{1-x} at high pressures have been studied using ab initio calculations. The study is focused on two phases namely zinc blende and NaCl. Besides, the transitiion pressures from zinc blende to NaCl structures for various compositions are determined. The calculations are performed using the full potential linearized augmented plane wave (FP-LAPW) method within the density functional theory (DFT) in both the local density approximation (LDA) and the generalized approximation (GGA). Detailed comparisons are made with published experimental and theoretical data and show generally good agreement. The information derived from this study may be useful for applications in solar cells, γ-rays detectors, infrared windows and other optoelectronic devices.

O4

Electronic structure and optical properties of $Si_{1-x}Ge_x$

Z. Rouabah,* *A. Bouzid, N. Bouarissa*.

Laboratoire Matériaux et Systèmes Electroniques, Centre Universitaire de Bordj-Bou-Arreridj, El-Anasser, 34265 Bordj-Bou-Arreridj, Algeria. Rouabah_zdz@yahoo.com

The electronic structure and optical properties of $Si_{1-x}Ge_x$ alloys are studied within the pseudopotential approach under the virtual crystal approximation. To make allowance for the compositional disorder, a correction to the alloy potential has been introduced. Features such as energy band gaps, refractive index and dielectric constants have been calculated. Special attention has been given to the effect of the lattice relaxation and alloy disorder on the studied physical quantities. The information derived from the present study may be useful for the use of $Si_{1-x}Ge_x$ for devices utilizing the energy of solar photons at an optimum.

CP2

DAAD Information Centre, University of Yaoundé 1, Yaounde Cameroon

Katja Buchecker, Brice Chuepo

DAAD Information Centre Yaoundé. Univesity of Yaoundé I, Nouveau Bloc Pédagogique R117

E-mail: daadkamerun@gmail.com. Website: www.ic.daad.de/yaounde/en

Since October 2009 the DAAD (German Academic exchange Service) is represented in Cameroon through an Information Centre located at the University of Yaoundé I. The Centre is opened to every people interested in study or research in Germany. The team of the Information Centre which is made up of a director and a programme officer organises activities within the following frame:

- Guiding students and university lecturers interested in study and research in Germany;
- Administrating DAAD scholarship programmes and assisting Cameroonian applicants in the constitution of their files;
- Counselling faculties and university managements in developing partnerships with German universities;
- Enhancing university partnerships through information seminars and events;
- Counselling former scholarship holders and other Germany alumni;
- Motivating Germans to study or do common research projects with Cameroonian universities.

The Centre is located at the University of Yaoundé I in Ngoa-Ekellé (Yaoundé) and is opened for personal consultations.

Office hours:

Mondays:	2 – 5 pm	Goethe Institute (Primary School Bastos)
Tuesdays:	2 -5 pm	University of Yaoundé I (New Pedagogic Bloc R.117)
Wednesdays	9 – 12 noon	University of Yaoundé I (New Pedagogic Bloc R.117)
Thursdays	9 – 12 noon	University of Yaoundé I (New Pedagogic Bloc R.117)

KL5

Concentrating Solar Power Technologies

B.F. Tchanche
Université de Lorraine, Nancy, France. *tfb_tchanchef@yahoo.fr*

According to a recent report released by the IPCC (International Panel on Climate Change), renewable energy sources could reach 43% of the world primary energy supply by 2030 and 77% by 2050. Concentrated solar power (CSP) technologies consisting of four main technologies: parabolic trough, central receiver, Fresnel reflector, and parabolic dish with very different design configurations and output characteristics could play an important role beside PV and wind systems. Favourable legislative conditions and fast depleting fossil fuels could prompt the awaited grid parity. Suitable areas have been identified and keys for future success and worldwide implementation are: cheap and reliable solar collectors, high plant efficiency, innovative designs, and cost-effective energy storage systems. The market is becoming consistent with increasing number of players: Acciona, Ausra, Abengoa, Solafrica, Siemens, Solar Millenium, Alstom, etc. Interest is growing all over the world and most countries in the Sun Belt have already set CSP programs: USA, China, India, Spain, South Africa, Algeria, United Arab Emirates, Australia, etc. At the moment, in regard to research and demonstration, USA and Spain have already taken the lead.

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KL6

Solar cell quality control by both recombination and electrical parameters determination: Application to a vertical parallel and series connected multijunction silicon solar cell

H. Ly Diallo[1]; Z. N. Bako[2], A. Gueye Camara[3], M. M. Dione[3], G. Sahin[3], M. Sane[3], M. Thiame[3], G. Sissoko[3]
[1]UFR/SET Université de Thiès, Thiès Sénégal.[2]Université de Maradi, Maradi, Niger.[3]Faculté des Sciences et Techniques, Université Cheikh Anta Diop de Dakar, Dakar, Sénégal. George.sissoko@yahoo.com

In this paper we present a new technic based on the junction recombination velocity for the evaluation of the electrical parameter for a vertical multijunction solar cell. After the resolution of the continuity equation the expression of photocurrent density and photovoltage are determined and the curve of the I-V characteristic are plotted; two equivalents electric circuit of the solar cell in open and short circuit are proposed allowing us to deduce the shunt and series resistance and their values for different configuration of the vertical mutlijunction solar cell

O5

Methodology to design a food stuffs solar drier

Yacoub I. Halawlaw

Département de Physique, Faculté des Sciences Exactes et Appliquées, Université de N'Djamena, BP 1027, Route de FARCHA, N'Djamena, Tchad. Tel.0023522529740 ; port. 0023566334048 ; e-mail : yacoubih@gmail.com

In this communication, we propose an approach allowing us to design a food drier. Food stuffs are mostly used in dried form in Africa. This makes drying and driers a subject of major concern. Many works have been performed in this field. Is it necessary to make a new attempt to propose a solution? A direct answer to this question is somehow pretentious but it seems to us the approaches used till now are mostly based on western criteria of effectiveness. We show why in this case, the proposed technology is either simply rejected or misunderstood and misused.

We show furthermore, that it is possible to design technical objects which may work fairly in a southern environment. We also propose a drawing by CATIA software of a solar drier.

KL7

Charge transport in bulk-heterojunction solar cells

Nadia Camaioni

Istituto per la Sintesi Organica e la Fotoreattività, Consiglio Nazionale delle Ricerche, via P. Gobetti 101, I-40129 Bologna (Italy) camaioni@isof.cnr.it

Last years have seen a rapid progression of the performance of the so-called bulk-heterojunction (BHJ) solar cells [1], made of an interpenetrated network of a conjugated polymer, as electron-donor (D), and a soluble fullerene derivative as electron-acceptor (A). This has been mainly achieved by the combination of improved material engineering [2] and fine control of the nanoscale morphology of the D/A blend [3]. Following the approach of the energy level engineering, novel donor materials with enhanced electronic properties have been prepared, leading to solar cell with efficiencies over 8% [4]. To further improve the power conversion efficiency of BHJ polymer/fullerene solar cells, much efforts are required to understand the factors limiting the device performance and, among them, the transport properties of charge carriers in the interpenetrated D/A blends are attracting greater and greater attention with respect to the past [5].

In this presentation, the critical role of charge transport in polymer/fullerene BHJ solar cells is discussed.

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O6

Qualitative, Optical and Structural Characterization of Titanium Oxide Thin Film Prepared by Sol-Gel Dip Coating Method.

Alabi, Aderemi B., Babalola Olayinka A.,*
University of Ilorin, Ilorin, Nigeria *remi050970@gmail.com

A wide band gap semiconductor, Titanium Oxide thin film has been synthesized as confirmed by the qualitative analysis carried out using X-ray diffractometer. Sol-gel dip-coating technique was used for the deposition at room temperature about 25^0C with sol gel prepared at different pH values 3 6, 7 and 10. The analysis revealed TiO_2, TiO, Ti_3O_5, and Ti_5O_9 as part of the oxides obtained by matching the reflection with the data base.

The resulting films were amorphous in nature as shown by the XRD spectrum with virtually no distinct peaks. The films were annealed at 450°C and 750°C for 2 hours. The XRD spectrum for the annealed films showed crystalline Titanium Oxide in anatase form at 450°C and Titanium Oxide in Brookite form at 750°C. Theses confirm the transformation by annealing the phases of Titanium Oxide.

The structural analysis carried out showed the particle size of thin films for pH 3 and 7 at room temperature, 450°C and 750°C to be 2.953, 2.869, 2.984 and 3.488, 3.358, 3.453, respectively. The UV-Visible spectrophotometer was used for the analysis of the films. It was observed that the absorption was high at wavelength between 400 nm and 500 nm. The band gaps were deduced from the graph of $(\alpha hf)^2$ and (hf). The result showed that at 450°C , the band gap at 3,6,7 and 10 values of the sol gel were 3.9, 3.1, 2.6 and 3.2 respectively. The band gap decreased with the pH values. The band gaps of the films at annealed 750°C at pH values of 3,6,7 and 10 were 2.2, 2.4, 3.1 and 2.9 respectively. This indicates a relative increase in the band gap at this temperature.

Titanium Oxide synthesized is therefore a nanomaterial for application in electronic devices such as dye sensitized solar cell and sensors.

ules from $5 per peak watt at the beginning of the 1990s to $2.5 per peak watt in 2009, or $0.7 per kWh, this remains effectively too high. Subsidies from some government policies and/or the carbon dioxide market to increase the utilization of clean energy for sustainable development can contribute to reduce the PV energy cost to $0.25–

0.40 per kWh during the first year of the system installation. This cost is similar to that of classic energy where energy cost is higher than $0.25–0.30 per kWh. For economic viability of this energy without subsidies, the development of ultralow-cost PV systems is one of the important issues to ensure a smooth transition to sustainable energy development [3]. It is known that the main idea of thin films is to use mostly low-cost materials (glass, metals, and plastics) and very little high-cost semi-conductors. This is because the few micrometers- thick semiconductor thin films deposited on a substrate surface take typically about 2–6 g m^{-2}, so even very expensive semiconductors (say, $1000 per kg) can cost very little at this level leading to an energy cost of a few cents per kWh [1,2]. But solar cell thin film technologies remain challenging for terrestrial applications [1]. On the other hands the whole significant challenge for solar light conversion to electricity or fuel is to develop PV, photo electrochemical, or photochemical systems that exhibit combinations of efficiency and capital cost per unit area that result in a total power cost of less than $0.50 per peak watt hydrogen produced by PV electrolysis. What is needed is to bring hydrogen cost down to $0.05 per kWh, which is similar to the present cost of hydrogen from steam reforming of natural gas. This work will describe the effect of the type of materials and technologies on the durability, cost and performance of photovoltaic solar systems for various applications. We will discuss on the necessity to improve the solar cell deices performance in view to make solar light conversion very attractive for large-scale applications. Comparison between crystalline and thin films solar cell technologies performances at various sites exhibiting different temperatures and light intensity will be determined. How to consider the appropriate technology for a specific application will be discussed.

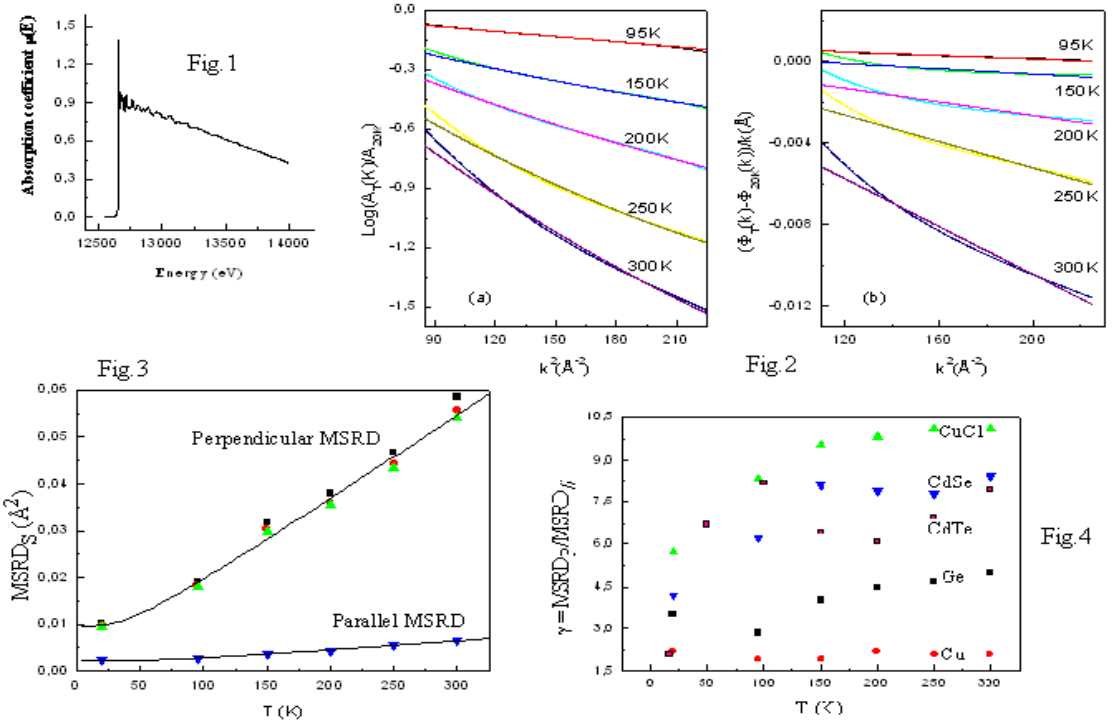
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O7

EXAFS study of thermal expansion in Cadmium Selenide compound

Bridinette Thiodjio Sendja
Université de Yaoundé I, Yaoundé, Cameroon; Université des Montagnes, Bangangté, Cameroon.
sbridine@yahoo.fr

Cadmium Selenide (CdSe) is an II-VI semiconductor compound showing peculiar electronic and structural properties useful in nuclear radiation detectors, solid state device in IR detectors, photo-electrochemical cells, nanoelectronic devices, solar energy [1]. X-ray diffraction (XRD) and extended X-ray absorption fine structure spectroscopy (EXAFS) have been found to be a powerful tool to study mainly thermal expansion in this type of material. Many studies are focusing now on the use of them for solar energy [2, 3]. We are interesting to the understanding of the thermal expansion property on CdSe. For that, EXAFS spectra recorded at Se K edge of CdSe in the temperature range 20-300 K have been studied [4]. Figure 1 presents an X-ray spectrum of CdSe recorded at 20 K. Data analysis process based on cumulant method has been used through amplitude ratio and phase difference methods. Both lead to the evaluation of even and odd cumulants, respectively, which allow description of thermal expansion (Figure 2). Thermal expansion of the Cd–Se nearest-neighbours bond measured by EXAFS is larger than the one measured by XRD. The discrepancy is justified by the high presence of perpendicular thermal vibrations. By fitting Einstein models to the temperature dependencies of the parallel and perpendicular MSRD, the presence of perpendicular anisotropy calculated by the γ ratio has been revealed. Figure 3 and 4 present parallel and perpendicular MSRD and γ ratio versus temperature of CdSe compared to other compounds. We found a strong and weak anisotropy in perpendicular direction, in some binaries and mono-atomics compounds, respectively. The first case presents an ellipsoidal distribution and the second, a spherical distribution of relative atom displacements.



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CP3

The Photovoltaic-Cluster *Solarvalley Mitteldeutschland* – Innovation by Co-operation

Daniel A. M. Egbe, [1]*Peter Frey*,[2]* *Sabine Schmidt*,[2] *Hubert Aulich*[2]

[1]ANSOLE Germany e.V, Semmelweisstr. 19, 07743 Jena, Germany. [2] SolarValley Mitteldeutschland GmbH, Konrad-Zuse-Str. 14, 99099 Erfurt, Germany. * p.frey@solarvalley.org

Solarvalley Mitteldeutschland (Central Germany), the PV cluster of excellence, strengthens its position as center of the German PV industry: 3000 new jobs, a award winning cluster, a strategic concept for research and an integrated training and further education system with the first interactive PV carrier portal in Germany. In this regional cluster, the leading producers and manufacturers from Saxony, Saxony-Anhalt and Thuringia are the driving force. They account for 40 percent of PV production in Germany. The efficient co-operation network between industry, science, education and politics ensures that innovations can be realized quicker. Technology development is being supported within the framework of a long-term innovation strategy co-ordinated along all the stages of the value chain from the refining of silicon to the integration of PV in buildings and landscapes, from basic research to innovative applications.

Currently, 35 companies active all over the world, 9 research institutions, 5 universities and 5 universities of applied sciences are pursuing three directions directly connected with one another in a jointly agreed strategy

- Technology development,
- Training and further education
- Cluster management.

The strategy is being implemented in 98 individual projects with a total budget of 140 million Euros over a period of 5 years.

Solarvalley Central Germany, the cutting edge PV-Cluster aims to make solar electricity competitive with conventionally generated electricity and to establish PV as the most significant energy technology of this century.

CP4

Yandalux GmbH, Hamburg Germany

Alexander Sipua Ngnoubamdjum

Yandalux GmbH Schellerdamm 4 , 21079 Hamburg, Germany, sipua@yandalux.com

CP5

Antaris Solar GmbH- Solair Afric Sarl, Yaounde Cameroon

Noa Simeon
Solair Afric Sarl, Yaounde Cameroon, solairafric@yahoo.com

KL8

The Solar Bottle and Solar Fountain: An educational tool for creating awareness of energy management

Mark Vervaart, Arnaud Delaille, Jean Therme*

CEA/INES R.D.I., Laboratory for Solar Systems (L2S), BP 332, 50 avenue du lac Léman, F-73377 Le Bourget-du-lac, France, Phone/fax : +33 (0)4 79 44 45 72 / +33 (0)4 79 68 80 49/ mark.vervaart@cea.fr

The origin of the Solar Bottle/Solar Fountain is an educational concept, based on the analogy between energy and water, developed for the ecological, educational 'Camp Nicolas Vanier' in the Vercors, in France. The concept can be easily adapted for the use of Rural Electrification as well. It is a portable battery pack in the form of a bottle that can be charged either by an individual solar module or a central charging station for multiple bottles at the same time: the Solar Fountain. Everyone has his own bottle and so responsibility for the charge and the use of his limited amount of energy. This in order to create awareness of the energy consumption, and on energy behalf to demonstrate how to live with the rhythm of the nature: when tomorrow the weather is bad, one should consume less energy today if one would like to have light tomorrow evening. It is like going for a long walk with a bottle of water; when one drinks all water at the beginning of the trip, one will be thirsty at the end unless you know that there is a water source on the way.

A close analogy to water has been maintained, because water is a universal and comprehensive way of explaining energy to people. Current has been transformed into current related audio-visual simulated water drops (a small speaker produces the sound of the water drops while charging), and the state of charge of the battery is indicated as a visual water level.

The Solar Bottle has a standard cigarette lighter plug as output as well as a USB plug for charging mobile phones, so many applicable appliances can be used: a 12V television/DVD reader, LED lighting, ventilator, etc… One bottle contains around 55Wh of energy. With low energy consumption applications, this gives relatively a lot of

possibilities. For each type of application, the amount of energy needed is given as a 'fraction of a bottle' (like 'one movie = 1/3 of a bottle'), understandable for everyone.

Implementation of the Concept in Rural Electrification

The present concept is a showroom of the technical state of the art, with Li-ion batteries based on iron phosphate positive electrodes, a new nano-power microprocessor consuming only 500nA, and a touch-screen on the fountain that is capable of functioning at -20°C (needed for the Vercores in winter) and a 180Wp prototype vacuum PV-module (NICE-concept) by CEA/INES. However, the essence of the concept, the analogy with water for explaining energy in the most basic sense, is applicable for most people all around the world. It would be a variation of the 'central charging station' with rental lamps existing in several countries, but with a privately owned (or rented) Solar Bottles with more functionalities than light only. The development of a low-cost version, both of Solar Bottles and the Solar Fountain, could hence reach the very large market, in which portable solar lamps and Solar Phone chargers are common practice.





First small-scale concept of the 'Solar Fountain' under construction at INES



Prototype of the Solar







Bottle, here the 'baby' version containing 25Wh



Design concept of Solar bottle and Fountain by the design school ENSCI in Grenoble, for at the camp of Nicolas Vanier

KL9

Quantification of aerosol requirements for forecasts of electricity production by concentrating solar systems

Armel Oumbe [a,b]*, *Marion Schroedter Homscheidt* [a]

[a] German Aerospace Center (DLR), DFD, Oberpfaffenhofen, Germany.[b] Current affiliation: Total Gas & Power, R&D – Concentrated Solar Technologies, France.obarmel@yahoo.fr

Sunlight is the fuel for any solar energy conversion system. Like any generation source, knowledge of the quality and future reliability of the fuel is essential for accurate analysis of system performance and financial viability of a project. For site selection, or selection of the most appropriate energy conversion technology, or design of a system for a specific location, it is necessary to understand the long-term spatial and temporal variabilities of available solar resources. Accurate resource data will remain essential to the efficient operation of a plant throughout its service life. Linear dependency between direct sunlight electricity production by concentrating solar power (CSP) system, as well as the energy needed to turn on the CSP system shows how essential is the sunlight information for the predictability of electricity production. More particularly, the integration of CSP into the electricity grid, as well as the participation in the electricity market requires day-ahead forecasting of the energy production. A high quality forecasting system reduces the risk of penalty payments and can increase plant profits by optimizing energy dispatch into the time periods of greatest value. When time-of-day pricing is in place, understanding of the diurnal pattern of sunlight may be more important than the estimate of the annual average.

CSP systems use lenses or mirrors and tracking systems to focus a large area of sunlight onto a small area. Because they rely on reflecting collectors, CSP technologies use direct normal irradiance (DNI). Therefore any discussion of the solar resource for CSP plants implies the analysis of DNI, which is the irradiance received from the solar disc only. Accurate information about the state of the atmosphere is essential for DNI estimation and forecast. In regions where clouds are rare and solar resource is large, such as Northern Africa, aerosol loading is the most critical atmospheric parameter on DNI estimation. Precise aerosol information are therefore indispensable for providing accurate irradiance forecasts since up to 30% of direct irradiance extinction due to aerosols have been reported. In dust storm, the extinction of DNI typically reaches 100%.

In this work, we analyze aerosol measurements in AERONET network, quantify which accuracy and temporal resolution are needed on aerosol optical depth (AOD) for DNI forecasting and evaluate the performance of a simple 2-day persistence of AOD. In addition to root mean square deviation (RMS) and bias, we consider also the percentage of hours where the deviation on DNI is higher than a given value. From the analysis of the intra-day

variation of AOD influence, we conclude that it is reasonable to use only one daily AOD in many stations – as it is currently done in most satellite-based method for SSI assessment. The relative deviation on DNI tends to increase with the mean AOD. In general, 2-days persistence of AOD can be applied in slightly turbid areas. For other areas, a chemical transport model, which provides better air quality forecasts, is needed.

O8

Rural Electrification in Cameroon -Lessons learned from 4 years of projects

*Paul Ngwe Mbeleg, Tobias Klaus**

International Solar Energy Research Center Konstanz e.V., Rudolf-Diesel-Str. 15D-78467 Konstanz; Germany.: Tobias.Klaus@isc-konstanz.de

ISC Konstanz is conducting rural electrification projects in Cameroon for 4 years. During that time, 2 villages were equipped with solar home systems, and several schools and health stations were given the opportunity use solar power for their electric devices. We will explain those projects and provide first results from what we learned since the first project in Summer 2008.

O9

Thermal Efficiency and Durability of Box Type Solar Cookers in India-An Experimental Study

R. Rajkumar,[e] M. Rajesh Kumar,[d] R. V. Jeba Rajasekhar,[c] A. Sundaram,[b] Tennyson Daniel,[a]*

[e] *Assistant Professor, Department of Futures Studies, Madurai Kamaraj University, India.*[d] *Research Scholar, Department of Solar Energy, Madurai Kamaraj University, India.*[c] *Assistant Professor, Department of Physics, Government Arts College, Melur, India.*[b] *Senior Professor & Head, Department of Solar Energy, Madurai Kamaraj University, India.*[*a] *Research Associate, Regional Test Centre (Solar Thermal), Madurai Kamaraj University.*rajkumar.sekaran@yahoo.com

The present study is an attempt to experiment different integral components of various box type solar cookers manufactured in India. The experiments were carried out at Regional Test Centre (Solar Thermal), functioning under the Ministry of New and Renewable Energy, Government of India and recognized by the Bureau of Indian Standards. The materials used in manufacturing various components of the cooker such as glass cover, cooking tray, cooker box, reflecting mirror, insulation, gaskets and sealants, cooking pots and caster wheels of five types (one sample from each type) of solar cookers available in India were studied. The dimensions of all these components were measured using calibrated instruments. The optical characteristics of the selected components and the figures of merit of the cookers of the present investigation were found experimentally. Tests such as leakage test, slam test, mirror reflectivity test, temperature test for paint, scratch test, exposure test, load test, thermal shock test, rain penetration test and thermal performance tests were conducted as per specifications of Bureau of Indian Standards (BIS) (IS 13429 : 2000). It was found that the transmittance of glass cover varied between 65% and 75% and the reflectivity of the reflecting mirror was 65% in most of the cookers. The figures of merit of the tested solar cookers were found to meet the specified requirements of BIS. Comparing the cookers having copper and aluminium cooking trays, it was found that the cookers having copper cooking trays had better thermal performance than those having aluminium cooking trays. Cookers having copper cooking trays attained maximum temperatures of 125 to 126 °C while those having aluminium cooking trays attained maximum temperatures of 110 °C. The figure of merit (F_1) of the solar box type cooker was calculated using the formula $F_1 = Tp - Ta / G$. The second Figure of merit F_2 was calculated by using the formula

$$F_2 \frac{T_1 (MC)_w}{A(t_2 - t_2)} \ln \frac{\left[1-\left(\frac{T_{w1}-T_2}{F_1 G}\right)\right]}{\left[1-\left(\frac{T_{w2}-T_2}{F_1 G}\right)\right]}$$

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O10

Investigation of the solar energy technology production in South Africa

Silas K Mulaudzi[1,2] *, Mammo Muchie[2]

[1]Energy and Electricity Division, City of Tshwane, P.O Box 440, Pretoria, 0001,[2]Tshwane University of Technology, 159 Skinner Street, Pretoria, 0001.Silasmu@tshwane.gov.za

Globally, the renewable energy industry is projected to grow rapidly in the next few years (REN21, 2009). The International Energy Agency estimates that 15-20% of total energy supply contribution will be from renewable energy by 2026. Investment in renewable energy sources for electricity, heating and in biofuels has increased considerably.

Nearly 11 GW of solar PV was produced globally. According to REN21 (2010) first Solar (which is in USA) became the first firm ever to produce over 1 GW in a single year. Major crystalline module price declines took place, by 50–60% by some estimates, from highs of $3.50 per watt in 2008 to lows approaching $2 per watt.

Energy utilization in South Africa is characterized by high dependence on cheap and abundance available coal. Furthermore, South Africa imports a large amount of crude oil, a limited quantity of natural gas is also available (Digest of South African Energy Statistics, 2009). South Africa has among some of the best solar resources in the world, the country has already committed itself to a target of 10,000 GWh of renewable energy by 2013 (DME 2003). According to the LTMS achieving renewable electricity supply targets of at least 27% by 2030 and 50% by 2050 would require a major rollout of Concentrated Solar Power (CSP) and solar Photovoltaic (PV) generation capacity. CSP is projected to contribute an installed capacity of up to 150 GW and solar PV up to 50 GW by 2050 (Winkler 2007).

Currently there is no CSP plant in South Africa. The Department of Energy in conjunction with Clinton Climate Foundation is planning to install up to 5000 MW CSP plant in Northern Cape. According to the model outcome of the LTMS achieving the large-scale rollout of CSP would require the construction of ten 100 MW CSP plants annually between 2014 and 2020, rapidly scaling this up to forty 100MW plants annually by 2030, and rolling out 100MW CSP plants in the region of 25 to 50 plants every year thereafter until 2050 (Edkins *et al*, 2009).

Solar radiation levels in South Africa are amongst the highest in the world, average daily solar radiation varies between 4.5 and 7 KWh/m2 (Banks and Schaffler, 2005). South Africa has the potential of generating up to 24 000 MW of CSP by 2030 given the excellent solar radiation available and infrastructure to support a project of such a magnitude (Edkins *et al*, 2009).

Similarly, South African does not have solar photovoltaic plant currently, developers are making an effort to construct these plants but due to a number and variety of factors the progress is slow. The barriers associated with solar power development are technology barrier, infrastructure and regulatory barrier as well as finance such as capital cost.

This study seeks to establish the import and export relationship between the domestic and international firms that manufacture solar energy technologies and the growth impediments in the renewable energy manufacturing industry

in South Africa. The solar energy technologies that will be considered in this research is solar PV and CSP The study will further exclude liquid fuels and non-electric renewable such as biofuel and Solar Water Heating (SWH).

The paper seeks to answer the following questions amongst others, which solar energy technologies are imported and exported from and to South Africa? Who is the user of these solar energy technologies in South Africa and why? What is the emerging type of manufacturers-users interactions in the solar energy sector? What are the factors hampering growth and development in the solar energy manufacturing industry in South Africa? Which regional, continental and international countries are these solar energy technologies imported from and exported to? What is the market force for export and import for these solar energy technologies?

The preliminary data was collected through a questionnaire from the different institutions across the country. These are government (Department of Science and Technology, research institution (Council for Scientific and Industrial Research), Association (Sustainable Energy Society for Southern Africa), consumers (residents in Mabopani, Pretoria), generator (Eskom) and academic institution (Fort Hare Institute of Technology). The questionnaires were completed by the senior management officials in these institutions. The comprehensive data collection will be collected through interview and reviewed questionnaire to all the relevant institutions.

Preliminary data collected from the academic, manufacturing, research institutions, association, consumers, generators and government have shown that the there is a strong link, bond, cooperation and support amongst the manufacturing companies locally, regionally and globally. The Government of South Africa has signed Memorandum of Understandings (MoU) with many Asian and European countries on solar energy development. These findings will be discussed further with the respondents.

The major factor hampering the development of solar energy seems to be institutional arrangement, regulatory framework, skills, policy uncertainty and gaps as well as economic climate. Both institutions interviewed are of the opinion that the current contribution of solar energy at this point in time is negligible. There are few solar PV that have been installed in commercial buildings for own power generation. The distribution of solar energy across the country is spread in accordance with economic hub compared to solar energy potential. Areas around North West, Limpopo and Mpumalanga have good solar potential but the application is very minimal.

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O11

Solar energy sustainability in Central Africa: Cameroon case study.

Joseph Kenfack[1*], Antoine Amie Assouh[2], Oumarou Hamandjoda[1], Dieudonné Kidmo Kaga[4], Blaise Biniom[3], Médard Fogue[5]

[1.]National Advanced School of Engineering, Yaounde, Cameroon.[2]University of Douala P. O. Box 1996 Douala [3]Electricity Sector Regulatory Agency (ARSEL) P. O. Box 30271 Yaounde, Cameroon. [4]Institut du Supérieur du Sahel, University of Maroua P.O. Box 46 Maroua Cameroon. [5]IUT Bandjoun, University of Dschang, B.P: 134 Bandjoun, Cameroon

** Corresponding author. Tel: +237 99 41 60 02, Fax: +237 22229116, E-mail: joskenfack@yahoo.fr*

Sub Saharan countries own important solar potential. This renewable energy source is still looking forward to its sustainability in the region, particularly in central Africa. Given its high cost, the growing demand and the poor energy access rate, the sub region is still abundantly using the fossil energy as main power source. Assessing the sector has resulted in identification of some core issues to be addressed in order to boost the sector.

Because of important power shortages, thermal plants are among other short term solutions planned or under construction. This solution is not environment friendly and hence is not relevant for a long term development.

The aim of this paper is to identify actions for improved access to sustainable, friendly, affordable solar energy services to users as well as a significant improvement of solar energy infrastructure in Central Africa and the promotion of renewable energy as a whole.

The work will show the solar potential and some applications in the area. Then identified obstacles for the promotion of solar energy will be targeted. Finally, suggestions will be made to help the countries develop a vision aiming at developing good solar energy policy to increase the status of solar energy and better contribute to fight against climate change and poverty reduction.

Cameroon case study is very interesting because the country has a great solar energy potential from wet forest to almost the dry desert. The state of art in energy sector in Cameroon will be examined. The overview of institutional structure reform of the Cameroon power sector will also be made with respect to solar energy, leading to specific suggestions based on the weaknesses of the institutions in connection with solar energy promotion, energy access and energy security in general. Specific suggestions will be made for remote areas in particular where the fight against poverty is more difficult. We will use several documents from institutions in the region and abroad, and maps when available.

Keywords: Renewable energy, Solar energy, Potential, Central Africa, energy policy, Cameroon

KL10

Converting Research Results in Solar Energy into Innovation: Ideas and Experiments in Strengthening the African Solar Energy Network

Mammo Muchie

SARChI Research Professor, IERI, Tshawne University of Technology, pretoriaProfessor of DIR , Aalborg University and Senior Research Associate, SLPMTD, Queen Elizabeth House, Oxford university, Uk. Email: mammo@cgs.aau.dk

Science, technology and engineering education and development are critical to transform the African economy from a primary commodity producing into a knowledge based economy. The primary, mineral and agricultural based economy has proved to be a burden rather than a help to Africa. It is estimated that something like 268 billion dollars flows out of Africa every year, and hardly less than 30 billion comes to Africa for the same period the outflow takes place. The economic structure that allows this gross outflow and inflow dynamics must be changed. It can be changed when new sources of research are organised to utilise such as the infinite source of the sun over Africa. Serious scholarly research must be organised to know what is invisible now in order to make African economies the real lions on the move. As Asia has their Tigers, Africa now has a few lions emerging with a rate of economic growth of above 8 % prompting even the usually pessimistic Economist magazine to declare in its editorial on December 2, 2011 about the African lions on the move . The Economist seems to regret calling Africa a hopeless continent by choosing the title for its editorial as the hopeful continent. This is a time when Europe and America are going through hard time now. The future of Africa is bright. All Africans have to do is organise systematically and on a massive scale a highly educated society that can build and sustain the African knowledge economy by moving away from the current dominance of a resource economy.

It is one thing to organise good research; it is another to find resourceful ways to transform the results of research into innovation by adding economic value to the novelty of the knowledge that the research produces. This is especially critically important for solar energy as the imperatives of climate change has descended upon the world and the alternative energy from solar power can make a big difference.

Thus one of the key challenges faced by developing economies in Africa is creating a system where the results of research can be commercialised by turning into innovation. In many developed economies, there are technology transfer offices that actually connect universities and the companies and other users who can convert research results into economic application.
This connection between those who do research and those who can convert the research into products and economic value by converting the knowledge into innovation is a critical one to strengthen the value of doing research. In many developing countries research cannot be a luxury. Nations will say they cannot afford to pay for luxury. The surest way of breaking this doubt by policy makers is when the funded research is to develop systematically the conversion of research results into innovation.
This new network set as ANSOLE for harvesting solar energy needs to give equal visibility to both the research side and the innovation side. The potential of Africa to be the power house for solar energy is huge. The solar energy research has to be organised systematically for trapping the sun, storing energy, distributing and maintaining the process at a huge economy of scale and scope levels. Equally important the innovation side must be organised and promoted side by side. This keynote address will produce how this research on a Pan-African scale can be stimulated simultaneously both at the basic research and development and the innovation levels. It also will explore how others especially in Europe can join and collaborate with a different and more equal logic than they have been used to by starting a fresh relationship in both research and innovation.
Today in Africa we are having the emerging African lions as the east Asia has the Tigers. Unfortunately much of the economic calculation for this is made by counting infrastructure, construction and services as well as the traditional primary commodity economy. This needs to change. The example of solar energy for this change will be explored how it can be done and how innovation can make a big difference will be explored.
The conclusion is to develop precisely how side by side with solar energy basic research , an innovation dynamics can be embedded to create supply with a demand , and demand that can stimulate supply. This way the conversion that Africa is truly embarking on a hopeful trajectory will be demonstrated.

KL11
Assessment of solar radiation over Africa: present and future

Lucien Wald
MINES ParisTech, Centre Energétique et Procédés, BP 207, 06904 Sophia Antipolis cedex, France
Lucien.wald@mines-paristech.fr

Assessment of solar radiation available at ground level is critical in many aspects, from exploitation of solar energy to climate research. The current means to assess solar radiation over Africa are discussed. There are a few stations in the meteorological networks measuring the global radiation on horizontal plane. Their number decreases in the years due to maintenance costs and other adverse effects. These stations are too few to produce a realistic view of the solar radiation that could be useful for any site located at more than 50 km from a measuring station.
A number of efforts were made to produce maps from satellite data since 1980. Satellite images cover the whole Africa and offer a high repetitivity in time, approximately one image every 30 min or 15 min. The MINES ParisTech has recently released the HelioClim-1 database which has been recognised as a critical Earth Observation priorities data set from the International Group on Earth Observation (GEO). HelioClim-1 has been computed from the Meteosat series of European satellites. It offers daily values of solar radiation for a period of 21 years for any site in Africa. Its access is for-free via the SoDa Service website (soda-is.com). The performances of HelioClim-1 compared to coincident ground measurements are discussed.
New parameters are currently derived from satellite data that describe the optical state of the atmosphere. These parameters can be input to sophisticated radiative transfer models which in turn provide accurate assessments of the global irradiation and its direct and diffuse components. This is the purpose of the MACC and MACC-2 projects funded by the European Commission. The results of the model for clear-sky cases will be presented. Finally, perspectives for 2015 and beyond will be discussed.

O12

Estimating hourly global solar radiation from satellites images

N. E. Erusiafe[1] and M. A. C. Chendo[2]

[1,2]Department of physics, Faculty of Science, University of Lagos, Akoka, Lagos, Nigeria.
mac.chendo@yahoo.co.uk Mobile phone:. 234-8030940911

One key aspect in the utilization of solar energy is being able to quantify the amount of thie energy that is available. There are not enough data for many locations in Africa, possibly due to financial and technical constraints. Weather satellites present a viable option for the assessment of the amount of solar radiation at the Earth's surface. This has been demonstrated by authors such as Cano *et al*. (1986), Mueller *et al*.(2004) and Rigollier *et al.* (2004) among others.

In this work, we have adopted the approach presented by Cano et. al. (1986). This involves determining and normalizing the Earth's reflectance – the portion of solar radiation reflected back to space and detected by the satellite's sensor – and the construction of a cloud index. Images of the Earth in the visible spectrum obtained from EUMETSAT were used for computing the cloud index for our location Akoka (lat. 6.51^0N; lon 3.40^0E), for the months April, 2010. The period considered are 09:00hours UT to 12:00hours UT. The cloud index obtained were correlated with the clear – sky index. The relationship obtained was used to estimate the amount of solar radiation for the hours considered. The deviation from measurements range from as high as about 18% down to about than 2%.

O13

The Status of Solar Photovoltaic and Solar Thermal Applications in Malawi

Tenthani, C[a*]; Senganimalunje, T[b]; Phiri, E[c]
[a]*Physics and Biochemical Sciences Department, The Malawi Polytechnic, Blantyre, Malawi.*[b]*Physics Department, The University of Malawi, Zomba, Malawi.*[c]*Electrical Engineering Department, The Malawi Polytechnic, Blantyre Malawi.**: ctenthani@poly.ac.mw

This paper presents the current status for solar energy applications in Malawi. Malawi is a Southern African country with approximately 85 % of the 13.6 million people living in the rural areas. Only 7.6% of the Malawian population has access to electricity. This figure accounts for 20% of the urban population and only 1% of the rural population. Solar presents a viable alternative because the country has good solar radiation resource of around 21 MJ/m^2/day for most times of the year. Although basic solar research is not well established in Malawi there are efforts to rectify this state of affairs by the government, institutions of higher learning, non-governmental organizations and to a lesser extent the private sector. Applied research mainly focuses on the adaption of PV systems developed elsewhere for local use with the aim of improving the quality of livelihoods. Efforts at designing PV power systems and manufacturing some of its components are starting to take shape. Traditional thermal applications of solar energy still dominate. Common applications in this category include passive space and water heating, clothes drying, raw and semi-processed food and fish drying. Opportunities exist for improvements in efficiency and hygiene by adopting technologies such as solar water heating and solar stills. New applications such as solar thermal cooking and power generation have good potential but require substantial investment. Current applications of solar PV include lighting, refrigeration, telecommunications and powering of low power electronic appliances. There are however, several barriers faced in the penetration of solar; the main one being high cost of capital equipment and high cost of spares.

Keywords: solar PV, solar thermal, Malawi

O14

Design and preliminary test results of three wind turbine battery chargers in Côte d'Ivoire.

Siaka Touré*[,b] [a] Diakaridja Traoré,
[a] *Laboratoire d'Energie Solaire Université de Cocody, Abidjan, Côte d'Ivoire;* [b]*Laboratoire d'Energie Solaire Université de Cocody, Abidjan, Côte d'Ivoire.*siakaahtoure@yahoo.fr

In the present paper, design and test results of three micro wind turbines, are reported. Three three-phase permanent magnet generators were produced. For each generator, the windings are arranged in the stator. The number of windings per notch is n. A three-phase winding was performed. The rotor carries the permanent magnets, resulting in a p poles system. The characteristics of the three generators are the followings: Generator 1 (Gen1): p=12, n=90; Generator 2 (Gen2): p=6, n=90; Generator 3 (Gen3): p=6, n=100. Gen3 is the biggest generator. The rotation of the magnets arranged on the rotor induces an electromotive force (emf) E. Electrical tests were made on the three generators. E was measured for different rotational speeds N (in rpm). A linear correlation E=a.N was found, with a=0.0595 (R^2=0.9998) for Gen1; a=0.062 (R^2=0.9998) for Gen2; a= 0.0961 (R^2=0.9834) for Gen3. The generators were also tested with a load resistance R=15 Ω. The currents I and the voltages V were measured for different rotational speeds, so that the curves I=f (N) and V=f (N) were known. The allowable electric power P=E.I was calculated and the following relationships were found: $P=0.002.N^{1.539}$ W (for Gen1); $P=0.002.N^{1.546}$ W (for Gen2); $P=0.000769.N^{1.785}$ W, R^2=1. The dimensioning of the gearbox was performed on the following basis: when the rotational speed of the rotor blades is 60 rpm, the generators yield at least a power P=100 W. Hence the transmission ratio K of the gearbox was gotten. K= 21.77 for Gen1; K=16.96 for Gen2; K=15.0 for Gen3. Then the gearboxes were built, with a single-stage gearing for Gen3 and a two-stage gearing for Gen1 and Gen2. Then the three nacelles were built. The tail vane was also dimensioned. Its surface s was estimated from the following relationship: s = 0.40.S.E/L. S is the swept area of the blades; E is the distance between the orientation axis and the rotor plane; L is the distance between orientation axis and the centre of the vane. The dimensioning of the blades was also performed. The diameter D of the blade is estimated from the following equation: $P_r=0.20.D^2.V_r^3$. Pr is the rated power (900 W), V_r is the rated speed (5 m/s).The result was D = 3 m. Using the strip theory, the sectional chord and the blade setting angles were estimated by the following equations: $\lambda_r = \lambda[r/R]$; $\Phi = [2/3].\tan^{-1}(1/\lambda_r)$; $C_l.B.l = 8\pi r\,(1-\cos\Phi)$;
$\beta = \Phi - \alpha$. λ is the tip speed ratio; λ_r is local tip speed ratio; r is the radial distance from the rotational axis; β, Φ and α are the pitch, the flow angle and the angle of attack, respectively. B is the number of blades [1]. Finally, linear leading edge and trailing edge were estimated and the blades were built. A rotating electrical connection was also built by a set of slip rings and brushes, as well as a lattice type tower 13 m high used to experiment the systems. Tests of battery charging were successfully carried out, with charging currents varying from 0.35 to 2 A.

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O15

Situation of renewable energies in the Central Africa region: the case of solar energy

César Kapseu [a,*], *Noël Djongyang* [b], *Mathurin Petsoko* [c]
[a] *ENSAI, University of Ngaoundere, Cameroon.* [b] *Faculty of Science, University of Ngaoundere, Cameroon*
[c] *FSJP, University of Ngaoundere, Cameroon.* [*] *kapseu@yahoo.fr Tel. (237) 77641211*

The achievement of sustainable development depends on reliable energy sources. In Africa, rural electrification poses particular challenges. Autonomous energy resources such as solar, wind or water are possible solutions. Solar energy is free, clean and inexhaustible. It can be used directly or converted into electricity through photovoltaic (PV) panels. Africa has one of the best climates for this type of energy. Most of the countries of the Central Africa region depend about 95% of hydropower. During the dry season, there is a low water resource and high solar resource. The opposite is observed during the rainy season. Hence the need to combine hydropower and solar energy. Among the 15 GW of PV capacity installed worldwide, Africa represents a very small proportion (about 15 MW). Solar energy is already used in its direct form (drying processes), and its indirect use (lighting) is growing rapidly. The will of rural households to benefit from this form of energy is evident among African leaders in general. Despite these advantages of solar energy, the cost of PV systems is still exorbitant. However, more homes could benefit from solar energy if the governments suppress the import duties. New methods of financing such as billing on use can also help to overcome the problem of prohibitive upfront costs. The use of solar panels supplying several homes at once can reduce costs, etc. Development of solar markets with special funds to facilitate consumer credit as done in most of the countries of southern Africa could also be a solution. Despite some lacks compared to the western or eastern

Africa, research in the field of solar energy in the central Africa region is increasing. Engineering schools, private institutes, programs facilitating the expansion of the use of solar energy, and nongovernmental organisations (NGOs) have embarked on research to produce technologies working with the Sun. The structures of sales and service of solar technologies are also increasing. Our countries rely heavily on their agriculture and their solar pumping will be highly useful. Ultimately, the future of Africa lies in solar energy. Where solar energy is used, development follows. The Sun has a bright future before him.

Keywords : Solar markets, Cameroon, wind, microhydropower, Temperature,

O16

Study of the relation between banks and producers of renewable energies goods

Aliou Dewa Bassirou.*

Université de Ngaoundéré, Ngaoundéré, Cameroun. E-mail : amiraliou@yahoo.fr

This paper presents the main trust relation between, banks and the producers of the articles of renewable energy. Sure enough, all the time, the fabrication of the renewable articles became from the high technology so need too much money. Thus, with the help of more universities, the renewable products are known too many successful. In this research, we will get the all motivation and all the risks in the relation between banks for investment and the producers.

***Key words*:** renewable energy, products, trust, banks, producers

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O17

Sustainable energies for rural development in sub-saharan Africa : Interdisciplinary approach and organisational challenge

Marthe Djuikom
Forum des Energies Renouvelables pour le Développement Durable et la Solidarité Internationale (FERDEDSI)
Weissenbruchstraat 8 – 1816 KR ALKMAAR The Netherlands. djuikom2@yahoo.fr / info@ferdedsi.net - www.ferdedsi.net

Perpetuation of precariousness and poverty in rural areas of Africa is mostly explained by the policies of development and local communities exclusion as part of main actors of systems and decision makers. These specific stakeholders, at individual and collective level, living in symbiosis in their environment , have developed various initiatives to satisfy daily needs.

Contrasting to what one could imagine, several ineffective and unsuccessful cooperation projects are not firstly due to technical, technological or financial problems, but mostly on organisational aspects, on problems of strategy of mobilization of the actors and low analysis of their own interests and the collective interests.

For instance, as far as energy is concerned, underexploited local natural resources are great potential for new opportunities. Promotion of PV in developing countries is a typical example of north-south technology transfer. Its specificity relies on the fact that, on the contrary of hydro electrification or biomass for instance, the supply of all the essential components is external from the region of implementation. So there is a need of efficient strategy for the local adoption of the innovation.

An effective participation and an efficient organisation for a real appropriation requires building an interdisciplinary team work at each step before any technical / technology intervention.

This paper proposes such a methodology, for putting renewable energies at the service of the poor in African rural areas.

Keywords **:** Sustainable development, renewable energies, solar energy, interdisciplinary approach,

O18

Country experiences: Solar radiation climatology in Côte d'Ivoire
Technique of implementing a station of solar radiation and meteoclimatic parameters measure for establishing a West African Solar Radiation Atlas.

Yao N'goran,[a] *Kouakou Konan*[b]
[a] *Université de Cocody, UFR SSMT, Laboratoire de Physique de la Matière Condensée et de technologie (LPMCT), 22 BP 358 Abidjan 22, Côte d'Ivoire, Tél.: 00225 22426226 / 07747671*,: ngorany@yahoo.fr

[b] *Département Génie Electrique et Electronique, Institut National Polythchnique Félix Houphouet-Boigny (INP-HB), Yamoussoukro, BP 321 Yamoussoukro, Côte d'Ivoire, Tél. : 00225 09963925 / 02147313,* akonanci@yahoo.fr

Site selection, dimensionment of solar energy production systems or calculating their efficiency depend significantly and essentially on the knowledge of the potential of solar radiation. This requires knowledge of this one at ground level as the input data required for modeling and classification of PV systems performs. In Africa, the measuring stations are unusual, while large gains in term of efficiency, coast, etc.. should be achieved by engineers, companies, agencies and institutes and research centers if appropriate information was easily available for anywhere and at any time. Hence the interest to perform a detailed mapping system (or atlas) of solar radiation in a given region to assist decision makers in their thinking on solar photovoltaic and thermodynamic projects. Our work describes a project of implementating station of solar radiation and meteoclimatic parameters measure on the site of University of Abidjan (Côte d'Ivoire) during one year (January-December 2010), and an overview of results of exploitation of the acquired data.
Keywords: Solar radiation, measuring station, atlas of solar radiation, solar, cartography, climatology of solar radiation.

O19

Solar drying of sludge

Thomas Nganya*, Patricia Arlabosse
Université de Toulouse, Mines Albi, CNRS, Centre RAPSODEE, Campus Jarlard, F-81013 Albi Cedex 09, France.: Thomas.nganya@mines-albi.fr, Tel: +33 5 63 49 30 93.

The sludge is composed of items collected at different stages of the purification of waste water: mineral matter in suspension, non-biodegradable organics and microorganisms, the latter resulting from the biological treatment. In exit of water-treatment plant, sludge are particularly liquid, which represents important volumes.
Solar drying of sewage sludge facilitates their energy valorization or agricultural. This is an effective way to stabilize them and to reduce their cost of transport.
Solar drying of sludge of water-treatment plant experiences a significant development since the years 2000. Unquestionably linked to the more important taking into account of the energy factor and more globally the environment, it is about a natural process of climatic drying. This technique is particularly adapted to the small installations and of average capacity knowing that the sludge must be dehydrated (beforehand). We present: the principles of this solar drying, the used materials and the principles of dimensioning.

Keywords: solar drying, sludge, sensors, greenhouse, dehydration.

O20

Electricity storage for PV energy: technological evolutions in stand-alone and grid-connected systems

*Mark Vervaart, Marion Perrin**

CEA/INES R.D.I., Laboratory for Solar Systems (L2S), BP 332, 50 avenue du lac Léman, F-73377 Le Bourget-du-lac, France,**Phone/fax** : +33 (0)4 79 44 46 44 / +33 (0)4 79 68 80 49/ marion.perrin@cea.fr

Storage is an enabling technology for the increased penetration of PV, as an evident mean to displace production in stand-alone systems, but moreover, as a mean to limit the grid impact of PV production in interconnected networks. In this context, the present paper will give an overview of the advances in terms of storage technologies used in both configurations as well as some results of research programmes on-going at CEA/INES on the aspect of battery management system in these two applications.

Storage for stand-alone PV systems

The general evolution in stand-alone systems goes in two directions: the growing market of small PV application (below 30Wp of PV), secondly a requirement of large PV and hybrid systems (over 1kW of PV)

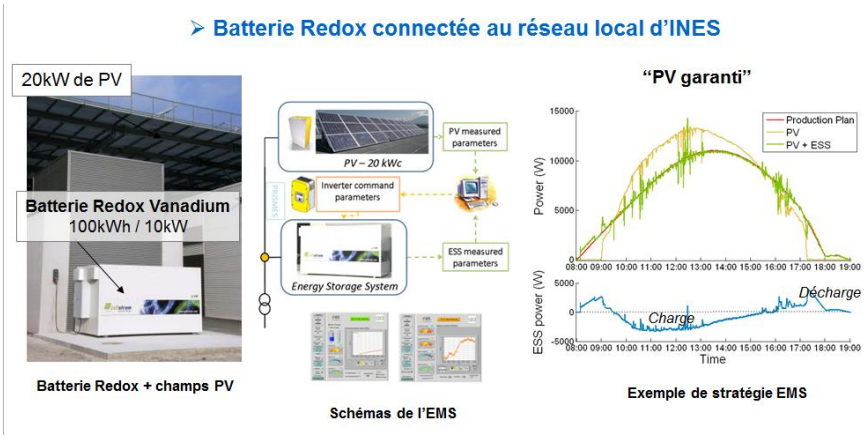
First we can observe an accelerated development and deployment of small PV applications such as PV lights. This development is related to the advances made in terms of consumption reduction and of production of high power LEDs coupled with the cost reduction of lithium-ion batteries. Therefore, more and more products come to the market that include lithium-ion batteries. In this issue, it has to be taken care of the lithium-ion technology that is used and to its thermal management in order to maximise the life of the system.

It is well accepted that ageing of lithium-ion batteries is increased by high temperatures and high state of charge.

Secondly, more and more demand is put on large PV and hybrid systems. In such systems, the preferred technology is still the lead-acid battery due to its low cost and good robustness. In this issue, CEA/INES had the opportunity to get a battery that was used for 24 years in a PV system in the south of France. The battery was of tubular technology, vented and is presently in investigation at the laboratory.

Large scale storage for grid connected PV applications: towards a warranty of the PV production

Regarding the massive introduction of PV in grid-connected configurations, experiences in weakly interconnected regions such as the French overseas territories show that a limit in PV power of 30% at any time of the year is a critical value below which measures must be taken to limit the variability of the PV production. Below that value, the stability of the network can be jeopardised. Therefore, investigations are on-going at CEA/INES to insure a PV warranty by coupling a PV plant with a storage system. That way, the system owner can edit 24h in advance a production plan, based on meteorological data, and due to the presence of a storage system, follow that plan afterwards and compensate for both fast fluctuations and prediction errors.



O21
Wind energy potential in Sahel

Saïdou Madougou[1], *Frederique Saïd* [2], *Bernard Campistron*[2]

[1]*Université Abdou Moumouni de Niamey (Niger).*[2]*Université de Toulouse, Laboratoire d'Aérologie, CNRS UMR 5560 (France).*Email**:** nassara01@yahoo.fr

The wind pattern in Sahel area is marked by a strong diurnal cycle (nocturnal low level jet by night and weak wind during daytime) as well as a strong seasonal cycle (higher Harmattan wind during the dry season and weaker monsoon wind during the rainy period). This variability requires an accurate analysis to be made of the wind potential.

By using wind turbines with hub heights situated at 150 m and blade extremities at 150 ± 60 m, we investigated the monthly wind power by two methods. The first involved the wind distributions directly observed. The second was based on the Weibull distributions which were fitted to the data. Day and night were compared. Results showed that the nocturnal low level jet was an attractive source of energy. The Harmattan period is very propitious for wind energy production throughout the whole day, with sites wind power exceeding 300 Wm^{-2} due to high wind speeds. Other periods favorable for wind energy production are: the nights and early mornings during the pre-monsoon and the monsoon periods, with a power exceeding 100 Wm^{-2} due to the nocturnal low-level jet. The post-monsoon is the least propitious for this energy production.

***Keywords*: 1.** Wind energy; **2.** Wind turbine; **3.** Nocturnal low level jet; **4.** Harmattan.

P1

IMPROVEMENT OF THE YIELD OF A PHOTOVOLTAIC SYSTEM BY THE APPROACH BASED ON THE ELECTRICAL LOAD PARAMETERS

AMELIORATION DE LA PERFORMANCE D'UN SYSTEME PHOTOVOLTAIQUE PAR UNE APPROCHE BASEE SUR LES PARAMETRES ELECTRIQUES DE LA CHARGE

A. Dandoussou[1], M. Kamta[1], E. Thoffo Houdji[2], Late B.[3]

[1] *The University of Ngaoundere, IUT, Department of Electrical Engineering,P. O. Box 455 Ngaoundere, Cameroon,E-mail: martin_kamta@yahoo.fr, dandoussou@gmail.com*

[2] *The University of Maroua, Institut Supérieur du Sahel, Department of Renewable Energy*

[3] *The University of Dschang, Faculty of Sciences, Department of physics. P. O. Box 96 Dschang, Cameroon.*

Abstract: This paper presents an approach of conception of a device needed to track the point of maximum power (MPPT) of a photovoltaic generator, according to the electrical load parameters. In fact, the model function parameters of the load are adjusted on the practical points by the least square method (LSM). The simulation of the current-voltage characteristic of the photovoltaic generator and of the load characteristic has helped to determine the positions of the duty points in relation to the maximum power points. This result has permitted to design a MPPT device adapted to the load and to the climatic and meteorological conditions of the site.

Keywords: *Model representation, photovoltaic system, MPPT*.*

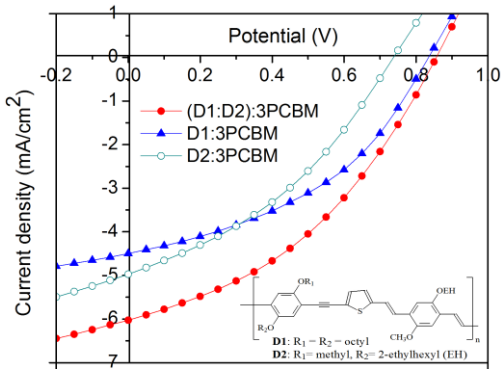
P2

Mobility and Photovoltaic Performance Studies on Polymer Blends: Effects of Side Chains Volume Fraction.

Getachew Adam[1,2], Almantas Pivrikas[1], Alberto Montaigne[1], Sisay Tadesse[1,2], Teketel Yohannes[2], Niyazi Serdar Sariciftci[1], Daniel A. M. Egbe[1]*

[1] Linz Institute for Organic Solar Cells (LIOS), Physical chemistry, Johannes Kepler University Linz, Altenbergerstrasse 69, 4040 Linz, Austria. [2]Addis Ababa University, Faculty of Science, Department of Chemistry, PO.Box 1176, Addis Ababa, Ethiopia.*daniel_ayuk_mbi.egbe@jku.at

A 1:1 mixture of two thiophene based poly(phenylene-ethynylene)-*alt*-poly(phenylene-vinylene)s denoted DO-PThE$_1$-PPV$_2$ (**D1**) and MEH-PThE$_1$-PPV$_2$ (**D2**), consisting of the same conjugated backbone but different types and volume fraction of alkoxy side chains on the phenylene-ethynylene unit, has led to enhanced charge carrier mobility (measured using CELIV technique) as compared to the individual polymers. The resulting ternary blend with PC$_{60}$BM showed better photovoltaic performance as compared to binary blends from the single polymers mixed with PCBM. This is due to improved active layer nanomorphology in the ternary system as revealed by atomic force microscopy (AFM) studies [1].



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P3

Vanadium dioxide based nanophotonics

A Simo*[a,b,c], R Madjoe[c], JM Ndjaka[b], S Zekeng[b], M Maaza[a]
[a]: Nanosciences African Network, Nanoscience Laboratories, Materials Research, Somerset West 7129, South Africa
[b]: University of Yaounde I, Cameroon,
[c]: Physics Department, University of Western Cape, Belleville, South Africa simo@tlabs.ac.za

Active materials such as semiconductor oxide nanophotonics with easily accessible changes of phase find extensive use as window suppliers adopting thermochromic films for energy efficient glazing. One of the most interesting material in switching resonance on and off according to solar conditions is VO_2 thin films with higher visible transmittance and greater transmittance modulation. Moderate optical modulation in spectral selectivity has many uses in photonics, with the added attractions of low cost and ease of implementation over large areas[1]. This ability to regulate the hysteresis loops with an easy process influences technological applications with enormous advances in electronics and computer science. The tunability of the band gap structure of VO_2 in turn the frequence produces generation and detection of the infrared wavelength. In this contribution the photonic multi-functionality of nanostructured VO_2 based coating is presented, implying applications as smart window for solar heat modulation, active coating for heat management in satellites, ultrafast opto-electronic gating, femtosecond tunable nano-plasmonics and infrared pulse generator for high speed IR shutter[2].

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P4

Experimental investigation of CPC with flat one-sided absorber: Energy and Exergy analyses

C. V. ALOYEM KAZE[*,a] , R. TCHINDA[b] and E. MBAKA NFAH[c]

[a]*M.D, University of Dschang, Cameroon,* [b]*Prof, IUT-FV Bandjoun, Cameroon,* [c]*Dr. IUT-FV*

Bandjoun, Cameroon Email: kazealoyem@yahoo.fr

In this work an experimental study of the compound parabolic concentrator (CPC) with flat-plate one-sided absorber is presented. Through this experiment, the hourly solar radiation (G_T) and corresponding ambient temperature (T_a) with the help of WINDEV software for the region is obtained. On the other hand, the exergy efficiency of (CPC) defined as the ratio of desired exergy to used exergy is determined taking into account the typical operating conditions of the collector. The result of this exergy analysis shows that the maximum exergy efficiency occurred at midday and evaluated at 3.036%. Furthermore, by least-squares fitting of the experimental data, the difference temperature and the exergy efficiency of CPC is summarized.

1. Energy and exergy analysis

Exergy analysis is a powerful tool for improving the efficiency of thermal processes.

According to Duffie at al. [1], the rate of heat received by the heat carrier, which is air here, from the CPC collector, is given by:

$$Qu = \dot{m}c_p\left(T_{Out} - T_{f,in}\right) \qquad (1)$$

$\dot{m}$ is the mass flow rate, T_{out} is the outlet temperature and $T_{f,in}$ the inlet temperature.

The daily exergy output rate can be written as

$$E_{\text{xdaily}} = \int_{6a.m}^{6pm}\left(\dot{m}\left[\left(h_{\text{out}} - h_{\text{in}}\right) - T_{\text{a}}\left(s_{\text{out}} - s_{\text{in}}\right)\right] - \frac{T_{\text{a}}}{T_{fin}}w_{\text{p}}\right)dt \qquad (2)$$

Where h is the enthalpy and s the entropy. w_p is the pump work.

2. Results

Fig. 1 presents solar radiation, inlet temperature,outlet temperature and the absorber plate temperature versus experiment time in CPC. The solar radiation increases in the morning to a peak value of 1000W/m^2

at midday (12:30) and starts to decrease in the afternoon in all days with clear sky condition. Inlet, outlet and absorber plate temperatures depend directly on the amount of solar radiation for mass flow rate 0.035 kg/s.

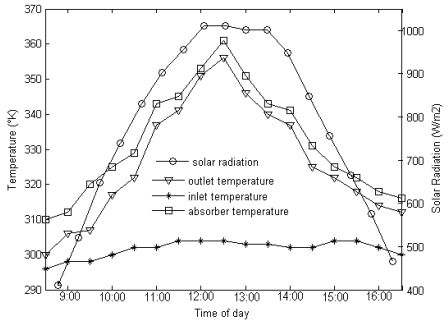


Fig.1. A typical experimental day for CPC

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P5

Optical properties of catechol and Alizarin dye TiO_2 nanowires from time-dependent density functional theory

B. M'Passi-Mabiala [1,2] , H.D. Douma*,[1,2,3,4] and R. Gebauer[4,5]

[1]*Groupe de Simulations Numériques en Magnétisme et Catalyse(GSMC), Université Marien Ngouabi, Brazzaviile, Congo*

[2]*Unité de Recherche sur les Matériaux et Energies renouvelables (UR-MATER), DGRST, Brazzaville, Congo*

[3] *Centre de Physique atomique et d'Optique quantique (CEPAMOQ), Douala, Cameroun*

[4]*The Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italie*

[5] *CNR-IOM DEMOCRITOS Simulation Center, Trieste, Italie*

E-mail: mpassi_b@yahoo.com

We present a computational study based on time-dependent density funtional theory of the optical absorption spectra of TiO2 nanowires sensitized with organic dye molecules. We concentrate on the Alizarin dye which is with the catechol one common organic dyes molecules. It is well known that although catechol and Alizarin are very simular molecules with analogos electronic spectra in tne free state, they show stark differences upon binding to titanium[1]. We compute adsorption geometries and energies and investigate the optical properties of the Alizarin dye TiO_2 combined nanowire system. In comparison to the one obtained in a previuos work for catechol dye TiO_2 nanowire system [2], we find that even if Alizarin and Catechol are in the same group in the gas phase, they have qualitatively different spectra that lead to an enhancement of the absorption in the visible frequency range with more activities of Alizarin than Catechol when adsorbed on a nanowire.

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P6

Comparative study of power supply systems for Relay stations of telecommunications in the northern area of Cameroon: case of the photovoltaic system and the generator group.

Bello Pierre Ngoussandou*,[a],

[a] *Ph.D. student, Maroua, Cameroon.* nbellopierre@yahoo.fr

The issue of climate change being that worse and the medium term fossil resources put clearly, the use of clean energies has become a priority of the United Nations.

Telecommunications Base Transceiver Stations (BTS) are more numerous in remote areas because of the spectacular growth of mobile telephony. In addition to climate change mentioned above, multiple injuries suffered by the users of telecommunications services and caused by interruptions of electrical power generators combined with the high cost of their operations, are reasons that have led us to the "comparative study of power supply systems for Relay stations of telecommunications in the northern area of Cameroon: case of the photovoltaic system and the generator group.

The sample used us springboard is the BTS (Base Transceiver Station or relay station) of CAMTEL in TCHABAL locality; 33 km from the Ngaoundéré-Garoua road. The first work was to study the current power system consisting of two generators. Secondly, the sizing of a photovoltaic system to ensure the same power supply was done. The combination of the both into hybrid system has thirdly studied.

The comparative study is then made on the reliability of these systems of power supply (generator, the solar system and the hybrid system). This study also takes account of their impacts on climate change and their immediate environment. Assessment of costs of installing and operating of the systems is also one of the aspects of this comparative study.

The generator group is to immediately very polluting and that it is less reliable. Its installation is however reduced cost compared to the PV system installation cost is five times higher. However curves (installation and operating) cumulative expenditure of both systems will give reason to green energy.

After having reached the strengths and weaknesses of one and the other system, the study of the hybrid system led to understand that the passage from generator group to the PV system can pass through this hybridization which has better performance than the first system.

Keywords: Renewable Energy - Photovoltaic System - Generator Group - Relay Station of Telecommunications - Electrical Sources Reliability.

P7

Thermomechanical characteristics briquettes and chemical energy based plant household waste

Yvette. Jiokap [a,*], *Inna Samomssa*[b*], *Kamga Richard* [c]

[a] *IUT, University of Ngaoundere, Cameroon.*[b] *ENSAI, University of Ngaoundere, Cameroon*
** jiokapnono@yahoo.fr Tel. (237) 75006441.*[*] *samomssa@yahoo.fr Tel. (237) 79839858 / 99824704*

In the world and Cameroon in particular wood is used for cooking meals and heating. This practice intensifies deforestation which leads to an excess of CO2 in the air that influences the climate. However the local population produces various types of waste. Because of the ease and low costs of land filling, for many years it has been adopted in the management of waste. At present it is applied in regions of Cameroon. However there is a generation in the landfill gas and leachate which poses risks to public health. In developing countries, biodegradable household waste, are an important source of energy for domestic heating, industrial and power generation. In this perspective we proposed to make the briquettes based energy waste plantain, cassava waste and waste of mango. So we proposed to evaluate the influence of humidity, size and pressure on the calorific value (PC) and the index of impact resistance (IRI) of the briquettes. It shows that cassava waste for the calorimetric power increases with the size, humidity and decreases with the diameter and the index of impact resistance increases with pressure.

P8

Transient study of silicon solar cell under pulsed electric excitation: determination of recombination parameters

I. Zerbo *[a], R. Sam [b], M. Zoungrana[a] , A. D. Seré[b] , A. T. Kam[c] , F. Zougmoré [c]
[a]Department of Physics, University of Ouagadougou, Burkina Faso; [b]Department of Physics, Polytechnic University of Bobo Dioulasso ,Burkina Faso; [a]Laboratory of Materials and Environment, Department of Physics, University of Ouagadougou, Burkina Faso.izerbo@univ-ouaga.bf

As part of solar cells characterization, the transient and modulation methods both experimental and theoretical measurements have been developed for determination of single or several recombination parameters [1-3]. The Open Circuit Voltage Decay (OCVD) method for the determination of the base effective minority carrier lifetime (τ_{eff}), effective diffusion length (L_{eff}) and intrinsic junction recombination velocity (Sf_0) of silicon solar cell has been investigated. The silicon solar cell under obscurity in a circuit is submitted to an electric excitation coming from a low frequencies generator delivering square signals. The transient regime occurs as soon as the excitation is cut in an abrupt way, one observes a phenomenon of tension relaxation due to a modification of the excess minority carrier density through the phenomena of diffusion and recombination in volume and in surface of the silicon solar cell. From the eigenvalue ω_0 of the fundamental decay mode and the decay time constant τ_c, minority carrier lifetime τ_{eff} has been calculated. Effective minority carrier diffusion length L_{eff} is then deduced and the intrinsic junction recombination velocity Sf_0 is also calculated.

Keywords: 1- Solar cell l; 2-Electric excitation; 3- Recombination parameters

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P9

Alimentation des sites isolés en Energie Solaire : cas des campements et des hôtels de tourisme au Cameroun

Kapseu C.*, [a], C. A. Koueni Toko [a], M. Kombi [b], A. Ahmed [c]

[a] *Ecole Nationale Supérieure des Sciences Agro-industrielles, BP : 455 Université de Ngaoundéré - Cameroun ;*
[b] *Ministère du Tourisme Yaoundé – Cameroun ;*
[c] *Institut Universitaire de Technologie, BP : 455 Université de Ngaoundéré – Cameroun.*
E-mail address : kapseu@yahoo.fr; anitokou@yahoo.fr

Le Cameroun regorge plusieurs sites touristiques dont certains sont isolés: ces campements et hôtels n'ont pas accès au réseau électrique conventionnel. L'une des manières de rendre ces sites attractifs est de les alimenter en énergie solaire. Cette énergie à l'avantage de produire le courant électrique (éclairage, pompage d'eau et alimentation des équipements), d'être une curiosité touristique en elle même (développement durable). De plus, cette énergie est gratuite et dans certaines zones comme l'Extrême Nord du Cameroun peut être disponible toute l'année. Un site a été choisi comme modèle dans le plateau de l'Adamaoua et avec des extrapolations appropriées, le dimensionnement fait peut être appliqué à d'autres sites. Avec un ensoleillement de 4,6 kWh / (j m²) et les besoins estimés à 12 000 kWh les calculs ont montré qu'on aurait besoin de 70 panneaux solaires. Si les autres appareils sont ajoutés, tels que les batteries, le régulateur et le convertisseur, le coût d'investissement global est évalué en fonction des matériaux utilisés, de leur origine, leur technologie de fabrication, de l'encombrement et de la logistique. Une simulation faite

montre qu'après 7 ans l'investissement est amorti. Après cette période, il ne reste plus que les dépenses dues à l'entretien des panneaux solaires et des batteries. Le Cameroun gagnerait à exploiter le potentiel solaire dont il regorge pour alimenter ses sites isolés et maintenir sa destination touristique.

Mots clés : Dimensionnement, panneau solaire, batteries, sites isolés, énergie solaire, simulation, extrapolation.

P10

Software tool support for simulation of a photovoltaic system running on a hot and dry climate

Laté B[1]., Dandoussou A[2]., Kamta M[2]., Tchinda R[1].

[1]*Université de Dschang, Faculté des Sciences, Département de Physique, B.P. 96, Dschang, Cameroun*

[2]*Université de Ngaoundéré, IUT, Département de Génie Electrique B.P. 455, Ngaoundéré, Cameroun*

The sun is the source of clean energy the best shared on the surface of the earth. The solar radiation can be directly converted into heat by thermal solar cells or into electricity by solar panels. Experimental results showed that the output of a solar panel does not exceed 60% under a hot and dry climate. To raise this handicap, a device of chase of transfer of maximal power (MPTT) is conceived and simulated thanks to an adapted computer tool. The results of simulation showed that the output of a photovoltaic system with a MPTT is optimum.

Key words. Optimization, photovoltaic system, MPTT*

**Maximum Power Transfer Tracking.*

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P11

Thermal characterization of a sensor solar plane low temperature

Elvis Mbou Tiaya [a]; Alexis Kemajou [a]
a: Laboratory of energy of The Physical Doctoral Formation unit and Sciences of the engineer University of Douala – Cameroon elvistiaya@yahoo.fr ; kemajoualexis@yahoo.fr

Today's world knows many problems bound to the production and the consumption of energy. It is mainly due to the more and more growing oil product shortages and to the very elevated cost of exploitation. Quoted of all this, comes to transplant itself the pollution and the global warming up generated by the use of these products. It poses itself a problem of survival and preservation of the environment then. Dice at the time imposes itself the necessity to think about the future while developing new sources of energies that are not polluting and easily reproducible to the scale of the time. It push us therefore to develop shapes of renewable so-called energies that is to

say that today's consumption doesn't affect the future uses and especially that won't have any negative effect on the environment in which we live.

It is in this optics that we moved toward the heating of water for the sanitary uses this by the slant of the sun. This last is therefore reproducible to the scale of the time renewable. To make it we used a plane solar sensor in which circulates of the water that transports the heat of the sun toward a storage capacity. The solar sensor is constituted of two sheet metal leaves made of steel and is painted in black in which one had quibbling welded (piece of valleys inside the sensor having for goal to orient the circulation of the fluid inside the sensor so constituted). The thus gone up whole is fixed on a pedestal with an appropriate slant so that the incidental rays of the sun are perpendicular to the surface of the sensor.

To arrive to our objectives we have modeless the system in the optics to provide to predict theoretical manner the behavior of our sensor. The modeless equation is show:

$$m_f\ c_f\ \frac{dT_f}{dt} + q_m c_f \left(T_f - T_{fe}\right) = \tau\ \alpha\ S\ G(i,\gamma) - \varphi_{pg}$$

In this equation, φ_{pg} is the losing heat in our solar senor per day. This equation concerns the solar sensor with a glass cover. Equation of our solar sensor without glass cover is:

$$m_f\ c_f\ \frac{dT_f}{dt} + q_m c_f \left(T_f - T_{fe}\right) = \alpha\ S\ G(i,\gamma) - \varphi_p$$

The numeric simulation is made thus during one day of every month of the year. The results show us that water comes out of the sensor to a temperature varying according to the hour of the day and that the maximal temperature is gotten at the solar noon that wants to say when the sun is at the zenith. This temperature generally varies according to brighten it of the day and is understood between 70 and 85°C. We can see on the figure the simulation case of January in the two case of our solar sensor:

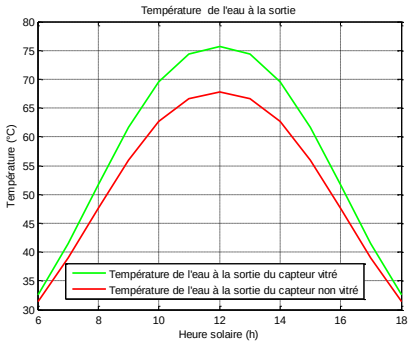


Fig.1: Simulation of January 2009 [2]

A tentative phase during the month of May has us permitted to confront the results theoretical of days concerned to the experimental results. This confrontation permitted us to say that the theoretical behavior of our sensor can be approached by the applied data gotten on our sensor.

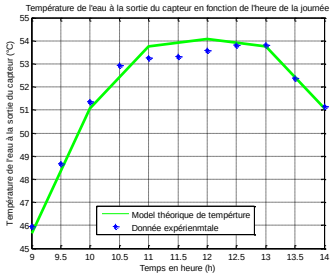


Fig.2: simulation and experimental point

The objective of this work being to characterize the sensor, we determined the characteristic factors of this last to know the optic factor and the global coefficient of loss our sensor.

The determination of these features made itself for the non glazed plane sensor. Our future works will have for goal to make an experimental survey pushed of these sensors on every month of the year. This time, we will work with the glazed plane sensor and the non glazed plane sensor.

Keywords: solar sensor, solar energy, simulation, experimentation, optic factor, global coefficient of losses.

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P12

Effect of Moisture content of Canarium fruit (*Canarium schweinfurthii* Engl.) on textrure pulp: application to pulp dehydration

Nkouam Gilles Bernard[a*], Kapseu César[b], Barth Danielle[c], Dirand Michel[c]

[a] Department of Agriculture, Livestock and By-products, The Higher Institute of the Sahel-University of Maroua, P. O. Box 46 Maroua, Cameroon, gillesnkouam@yahoo.fr.[b] Department of Process Engineering, ENSAI-University of Ngaoundere, P. O. Box 455 Ngaoundere, Cameroon.[c] Laboratoire Réactions et Génie des Procédés UPR CNRS 3349 ENSIC-INPL, 1 rue Grandville, BP 20451, 54001 Nancy Cedex, France

Effect of water content of canarium pulp (*Canarium schweinfurthii* Engl.) on texture pulp was investigated. Canarium fruits were stored at 18°C and -33°C for 24 months. The *Instron* apparatus was used to determine the textural changes and microscopic observations were done using a scanning electronic microscope. Pulps of the canarium fruits stored at 18°C were significantly ($p \leq 0.05$) harder (from 402.51 ± 68.27 to 1438.58 ± 152.70 N) than those stored at -33°C (from 15.08 ± 1.63 to 22.28 ± 2.52 N). These correspond to a decrease in moisture content (from 55.21 ± 0.19 to 8.04 ± 0.11) at 18°C while the moisture content remained stable at -33°C. Cohesiveness of the pulp at 18°C was the largest. Chewiness of the pulp of fruit stored at -33°C was the smallest (13.22 ± 3.81 J), while their springiness was the highest. Storage at -33°C gave the best textural characteristics of the canarium fruits, which conserve their edible character. The results on the correlations between moisture content and hardness (-0.92), cohesiveness (-0.72) and chewiness (-0.66) showed that the less pulp is dehydrated the more fruits is edible. These results also confirmed that the suitable and "soft" method should be choosen to dry canarium pulp.

Keywords: *Canarium schweinfurthii* Engl., temperature, textural changes, dehydration.

P13

Solar technologies for buildings

Noël Djongyang [a,*], René Tchinda [b], César Kapseu [c]

[a] Department of Physics, Faculty of Science, University of Ngaoundere, Cameroon.[b] IUT Fotso Victor, Bandjoun, University of Dschang, Cameroon. [c] ENSAI, University of Ngaoundere, Cameroon. [*]
dnoel102000@yahoo.fr

Buildings account today for about 40 % of the final energy consumption, showing that the reduction of energy consumption in buildings is of high socio-economic relevance. Most of the countries worldwide are now engaged and have committed to reducing the emission of greenhouse gases responsible of the global warming. Buildings have to play a major role in achieving this goal. The directive for energy performance of buildings is therefore an attempt to unify the diverse regulations, to define minimum common standards on buildings' energy performance and to provide certification and inspection rules for heating and cooling plants. The distribution of energy use varies with climatic conditions. In Germany for example, where 44 % of primary energy is consumed in buildings, 32 % is needed for space heating, 5 % for water heating, 2 % for lighting and about 5 % for other electricity consumption in residential buildings. This is not the case for African countries. Building technologies require energy to overcome

their objectives. The heating energy requirement of buildings can be reduced from today's high levels to almost zero if buildings are thoroughly insulated, passive solar gains through windows are used efficiently, and the supply of fresh air takes place via a heat-recovery system. However, all buildings still have an energy requirement for electricity and warm water provision which cannot be met by passive measures. Active solar technologies are especially appropriate for meeting this energy requirement, as the elements can be integrated into the shell of the building, thus substituting classical building materials and requiring no additional area. Solar modules for photovoltaic electricity production can be built like glazing into all common construction systems, and are characterised by a simple, modular system technology. Thermal collectors with water and air as heat conveyors are installed for warm water provision and heating support, and can replace complete roof covers if the collector surface is large. For today's increasing air-conditioning and cooling demand, especially in office buildings, thermally driven low-temperature techniques are interesting; these can use not only solar energy but also waste heat. Apart from electricity production, solar heating and cooling, solar energy is used in the form of daylight and thus contributes to a reduction in the growing electricity consumption. The aim of this paper is to deal with all solar technologies relevant to meeting the energy requirements of buildings, so that both the physical background is understood and also concrete approaches.

Keywords: buildings, solar technologies, heating, cooling, passive solar

P14

SSESAMUM INDICUM L.: A POTENTIAL SOURCE FOR PRODUCTION OF BIODIESEL

NOUADJEP Serge Narcisse*, KAPSEU César, NSO Emmanuel

*Department of process engineering, National School of Agro-Industrial Sciences, University of Ngaoundere, B.P. 455 Ngaoundere, Cameroon.*Email: Nouadjep@yahoo.fr

Renewable energy sources are receiving increasing attention with decreasing oil reserves and increasing environmental consciousness. The present study entitled: "*Sesamum indicum* L.: A potential source for production of biodiesel", fits well within the politics of future prospective source of energy and alternate diesel fuel production. The sesame oil was extracted by means of traditional solvent extraction with use of ethyl acetate as solvent from the sesame seed sold in the market in Ngaoundere. The oil was then characterized and biodiesel was prepared by transesterification of the crude oil using ethyl alcohol of 95°, with potassium hydroxide (KOH) and concentrated sulphuric acid (H_2SO_4) as alkaline and acid catalysts respectively. With extraction yield of 50.23 %, the conversion rate into ethyl esters using acid catalyst is in the range of 60.17 % and 74 % using alkaline catalyst. The fatty acid composition of sesame oil is similar to the one of the oils that are commonly used in biodiesel production. Physicochemical analyses of the sesame oil as well as the one of the transestérification product shows improvement in fuel properties of sesame seed oil with a cetane number of 51.4; a heating value of 40.1 MJ/kg; iodine number of 109.11; density of 0.860 and viscosity of 1.23 cSt with respect to ethyl esters of sesame oil against 56.77 cSt; 0.910; 39.92 MJ/kg et 50.13 respectively for viscosity, density, heating value and the cetane number according to sesame oil. Though the observed, cetane number (51.4) for the produced biodiesel is less than the one of biodiesel obtained from Jatropha oil (59), palm (62); it is close to the one of biodiesel from rape-seed oil (49-51), greater than the one from sunflower oil (49) and comply with the European and American standards with respect to biodiesel.

Keywords: biodiesel, transesterification, sesame, cetane number, fatty acid, vegetable oil.

P15

Three dimensional approach for polycrystalline vertical junction silicon solar cell

SISSOKO Grégoire[1], NOUHOU BAKO Zeïnabou [1,2]

[1] Laboratoire des Semiconducteurs et d'Energie Solaire, Département de Physique,FST, Université Cheikh Anta Diop, Dakar, Sénégal.[2] Département de Physique, FST, Université de Maradi, Niger

By making a mathematical modeling of a grain of the solar cell, the internal efficiency quantum evolution of three-dimensional is studied according to the modulation of frequency. The phase of internal efficiency quantum, always under frequency modulation. The analysis of internal efficiency quantum and its phase is restricted from 0, 4 to 1.1µm (i.e. .to visible from infrared) coupled with a modulation frequency varying from 10^3 to 10^7 rad.s^{-1}, for a recombination velocity Sf in the junction which heading towards + ∞.

Finally, the last part introduces an added value belong to the laboratory which is the determination of electrical parameters. It is a new concept which consists in the determination of series and shunt resistances.

The peculiarities of this work lie in the fact that the electrical parameters are acquired from the Niquist diagram of the spectral response. The theoretical result acquired by the Niquist diagrams, allows us to determine resistor and self behavior of the material.

P16

Biogas Production by co-digestion of banana peelings and Pig Manure

Nso, E. J.*[,a]; Feudjio D., C.[a] ; Kapseu, C.[a]

[a] *Département de Génie des Procédés, Ecole Nationale Supérieure des Sciences Agro-industrielles (ENSAI),Université de Ngaoundéré, BP 455 Ngaoundéré, Cameroun.*: nso_emmanuel@yahoo.fr

Biogas is a renewable energy which has proven its viability as alternative energy in the current energy and environmental crisis in developing countries. Current trends in population growth, development of the agricultural sector and value chain are pointers to a rise in energy demand. These activities generate large amounts of organic wastes which are recyclable into biogas energy. This laboratory study was made to evaluate the production of biogas by co-digesting banana **peels** and pig manure. A system of 10 batch bio-digesters of 1000 ml each, without stirring, in single-stage and of free cells culture type was mounted. The response surface methodology (RSM) with a two-factor Doehlert design was used to evaluate the effect of banana peels/pig manure ratio (X1), and total solids content of the medium (X2). The temperature was set at 35 °C. The quantity of methane produced and the variation of pH were experimental responses used to evaluate the operation. The proposed models for the description of process were second order polynomials with double interactions. It appears from this study that co-digestion of banana peels and pig manure enhances the stability of the pH of the system and the biogas yield. The best banana peels/pig manure ratio obtained was 25/75 at 4% of total solids. The effect of this ratio could be due to the supplementation of nutrients by the two substrates. This would induce a simultaneous and compromising development of both methanogenic and acidogenic microorganisms. The effect of the dry matter content could be linked to the difference between the production and the consumption rates of organic acids. These results show that biogas can be produced by co-digestion of pig manure and banana peels.

Keywords: Biogas, Renewable Energy, Organic Wastes, Co-digestion, System Stability, Yield.

P17

Optical properties of MEH-PPV and MEH-PPV/ [6,6]-Phenyl C61-butyric Acid 3-ethylthiophene Ester thin films

Bushra Mohamed Omer*,[a] and Ahmed Khogali Mohamed[b]

[a]*Department of Applied Physics and Mathematics, Faculty of Applied Science and Computer, Omdurman Ahlia University, P.O.Box 786, Omdurman-Sudan.*[b]*Alternative Energy & Sustainable Development Centre, Omdurman Ahlia University, P.O.Box 786, Omdurman-Sudan.** bushra_omer4@ yahoo.com

Thin films of Poly [2-methoxy-5-(2-ethylhexyloxy)-1, 4-phenylenevinylene] (**MEH-PPV**) were prepared from chloroform, 1,2dichlorobenzene and toluene solutions by spin coating technique on quartz substrates. Absorption and photoluminescence (PL) spectra of the polymer thin films prepared from different solvents were measured. It was concluded from the UV-Vis absorption and PL spectra that the optical properties of MEH-PPV films strongly affected by solvents used for spin coating. A strong photoluminescence quenching was observed in (1:4) MEH-PPV:[6,6]-Phenyl C61-butyric Acid 3-ethylthiophene Ester (**Modified Fullerene**) composite which provides evidence of photoinduced charge transfer. Further, with Atomic Force Microscope (AFM) it has been demonstrated that the surface morphology of the MEH-PPV: Modified fullerene thin films depend strongly on preparation condition (solvents).

Keywords: *MEH-PPV; Modified Fullerene; Optical properties; AFM*

P18

Design, simulation and realization of an intelligent charge controller for accumulators in renewable energy power stations

Patrice Désiré Dongo,[a,b] Christian Tchapga Tchito,[a] Robert Tchitnga*,[a,b] André Rodrigue Tchamda,[a] Julius Tangka Kewir,[b] Anaclet Fomethe[c]

[a]*Research Group on Experimental and Applied Physics for Sustainable Development, 'RGEAPSD', University of Dschang, Cameroon;* [b]*Laboratoire des Energies Renouvelables, 'LER', Université de Dschang, Cameroun;* [c]*Laboratoire de Mécanique et de Modélisation des Systèmes, 'L2MS', Université de Dschang, Cameroun*
E-mail address: tchitnga@yahoo.fr

Renewable energies contribute enormously in the protection of the environment in the sense that their use reduces the growing problem of global warming. But the renewable energies sources in general and the solar energy source in particular are known to be fluctuating and irregular in their availability. This later character justifies the necessity for the development of storage means for permanent or long last use such as batteries and accumulators. The relative high cost of batteries and their fragile character impose to pay particular attention both in the use and in the maintenance, to guaranty a long life use.

We are proposing an intelligent charge controller for batteries with multiple functions piloted by a microcontroller PIC16F877. As particular features, it detects and takes into account the ambient temperature around the battery, which is a parameter that strongly influences the life last of batteries during the charge and discharge processes. This temperature is then controlled by setting a cooling or a heating system on, according to the necessary requirements indicated by the fabricants. It ensures too the protection of battery against many annoyances, that can occur during its charging and discharging cycles. It also manages the loads for a rational use of the energy produced.

P19

Renewable energy production fromalgae: Spirulina

Yvette. Jiokap [a,*], *Paul Kouteu*[b*], *Cesar Kapseu*

[a] *IUT, University of Ngaoundere, Cameroon.*[b] *ENSAI, University of Ngaoundere, Cameroon*

** jiokapnono@yahoo.fr Tel. (237) 75006441*kpaulous@yahoo.fr Tel. (237) 76218306 / 97505159*

In recent decades, the world is facing a significant increase in its energy demand, rising oil prices, depletion of fossil resources programmed, and the fight against the emission of greenhouse gas emissions. Faced with these growing concerns, the search for sustainable alternatives is required.Renewable energy (wind, solar, hydro, biomass) are a set of solutions because it reduces dependence on oil and towards pollution of the environment. The transport sector dependent on oil especially considering the potential for development of biofuels from plant biomass, such as bioethanol. Bioethanol is the result of the bioconversion of sugar fermentation by micro-organisms, usually yeast. Algal biomass as a raw material of choice for the production of bioethanol. Lake Chad has many algae such as chlorophycophytes, the rhodophytes, the cyanophytes and diatomophytes. Among the cyanophytes, we find that spirulina has many possibilities. In terms of biofuel production, it has proven particularly in the production of biodiesel and bio-oil, but the ethanol component has not yet been explored. A trial production of bioethanol from that spirulina is underway in our laboratory. To achieve our goal, a comparison is made between pretreatment with dilute sulfuric acid pretreatment and NaOH. This pretreatment will be used to release and separate the polysaccharides trapped in the algal cells into fermentable sugars. Three parameters of this pretreatment are examined include: the concentration of acid or base depending on the type of pretreatment (1-10%, v / v), temperature (100-200 ° C) and time of pretreatment (5-60 min). Once the sugars released, they are fermented by the action of Saccharomyces cerevisiae for bioethanol. The ethanol produced will be used to power tractors for agriculture and ease the task of our dear mothers.

Keywords: Bioethanol, Renewable energy, Algae, Spirulina, Lake Chad

P20

DETERMINATION OF CRITERIA FOR THE CHOICE OF PHOTOVOLTAIC CELLS

Armel Duvalier PENE[*, a], César KAPSEU, [a] Laurent BITJOKA, [a] George ELAMBO NKENG, [b] Daniel EGBE, [c]

[a] University of Ngaoundere, Cameroon duvalierarmel@gmail.com Tel : (237)77197509.[b] Higher national school of public works of Yaounde, Cameroon.[c] Linz Institute for Organic Solar Cells, Johannes Kepler University Linz, Austria

Cameroun as good number of the countries in development process still has a great deficit of electric power. The local distributive firm is no more able to satisfy all the population. The use of photovoltaic solar energy is one of the solutions to especially make the power electric accessible to all the population in the rural zones of which the inaccessibility to electricity lead to underdevelopment and supports the rural migration. Photovoltaic solar energy: is the direct conversion of the solar radiation to electricity trough photovoltaic solar cells. Being given that there are several types of photovoltaic solar cells (according to the manufacturing technology), the objective of this study is to define and suggest criteria that can help in the choice of the photovoltaic solar cells. Several cells were identified and

the photovoltaic cells most widespread consist of semiconductor, mainly containing silicon. To make the choice of a cell, it is necessary to have an idea on the manufacturing technique, operations, the output, the cost, the performances of the cell, the sunning of the medium of the installation, it is as well necessary to dimension the installation. This proposal for a method of choice makes it possible to avoid, the losses of money and the problems of maintenance.

Keywords: Photovoltaic energy, photovoltaic cell, dimensioning, sunning, tropical area.

P21

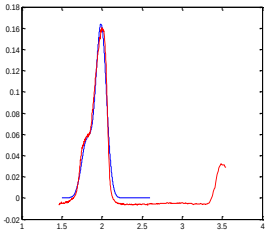
Correlation between emission spectrum and diffusion rate using Franck-Condon analysis in Solar Cell Polymers

M. A. Saidani[*,a], Ö. Usluer[b], Z. Ben Hamed[a], A. Ben Fredj[a], F. Kouki[a], S. Romdhane[a,c], D. A.M. Egbe[b] and H. Bouchriha[a].*

[a]*Unité de Recherche Matériaux Avancés et Optronique, Faculté des Sciences de Tunis, 2092 Campus Universitaire Tunis, Tunisia.*[b]*Linz Institute for Organic Solar Cells, Johannes Kepler University Linz, Altenbergerstr. 69, 4040 Linz, Austria.*[c] *Faculté des Sciences de Bizerte, 7021 Zarzouna, Bizerte, Tunisia.*Samir.Romdhane@fsb.rnu.tn

Great efforts have been made to improve the efficiency of the optoelectronic devices based on semiconductor materials. The success of such devises needs a deep understanding of the excited state photophysics. In some respect, the study of exciton migration can complement the information gained from charge measurements [1-3]. The energetic disorder present in the material and the amount of lattice relaxation associated with the charge are the key parameters that govern the excitonic motion and can be obtained through a Franck-Condon analysis where the spectral intensity is approximated by the superposition of transitions between the vibrational frequencies of the ground and the excited electronic states [4-6].

In the present work, we have measured the emission spectrum of a side chain based statistical copolymer named (**AnE-PV*stat***) [7]. The experimental emission band shape was theoretically reproduced (Fig.1) taking into account only the C=C bond stretching vibrational mode leading to an estimation of the Huang-Rhys factor which corresponds to the average number of phonons involved in the emission process. The relaxation energy associated with the geometrical rearrangement after an excitation or de-excitation process is also inferred from the emission spectra. The obtained values reveal a low exciton-phonon coupling and high electronic coupling resulting in a relatively high diffusion rate.



Experimental emission band shape (red curve) Franck-Condon fit (blue curve)

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P22

Eigen modes of a wind turbine wooden blade

Siaka Touré*[,b] [a] Rodolphe Kalou Bi Troh

[a] *Laboratoire d'Energie Solaire Université de Cocody, Abidjan, Côte d'Ivoire;* [b]*Laboratoire d'Energie Solaire Université de Cocody, Abidjan, Côte d'Ivoire*siakaahtoue@yahoo.fr

The design of a wind turbine involves the vibration frequencies study of the structure. In the present work, a wooden blade is studied. The wood type is teak (tectona grandis). A three-blade 1 KW wind turbine was considered. At first, the diameter D of the blade was dimensioned, by the following relationship: $P_r=0.20.D^2.V_r^3$. Pr is the rated power (1000 W), V_r is the rated speed (5 m/s).The result was R = D/2 =3.16 m. Then the sectional chord and the blade setting angles were estimated by the following equations: $\lambda_r = \lambda[r/R]$; $\Phi = [2/3].\tan^{-1}(1/\lambda_r)$; $C_l.B.l = 8\pi r(1-\cos\Phi)$; $\beta = \Phi - \alpha$. λ is the tip speed ratio; λ_r is local tip speed ratio; l is the chord; r is the radial distance from the rotational axis; β, Φ and α are the pitch, the flow angle and the angle of attack, respectively. B is the number of blades [1]. The blade was discretized into ten elements. l_0 and l_{10} are the values of l at the root and at the tip of the blade, respectively. For linear leading and trailing edges, l_0 and l_{10} were calculated. l_0 = 41.47 cm. Then the cross-sectional areas s of the different blade elements were calculated, by assuming that they are elliptical. A mean value s_m was calculated: s_m = 0.0047 m². The mass per unit length μ_m was found to be: μ_m = 3.15 Kg/m, for a total mass of the blade equal to 9.95 Kg. Then the second moment of inertia, I_z was calculated. It is given by $Iz = \iint_s y^2\, ds$. Its value is $Iz = 1.357.10^{-5}\ m^4$. The eigenmodes of vibration of the blade were investigated. For the eigenmodes, only the loading due to the gravity is considered. Let T, M and v (x,t) be the shear force, the bending moment and the deflection, respectively. They are linked by the following equations: $M(x) = E\, I_z \frac{d^2V(x,t)}{dx^2}$. (1)

$$E\, Iz \frac{d^4V(x,t)}{dx4} + \mu_m \frac{d^2V(x,t)}{dt^2} = 0 \quad (2)$$

The solution of equation (2) was looked for, by writing the deflection as follows:
v(x,t) = f (x).g (t). From equation (2), the following solutions were found:
g (t) = Acosωt + Bsinωt (4)

$$f(x) = Cch\left(\sqrt{\frac{\omega}{c}}x\right) + Dsh\left(\sqrt{\frac{\omega}{c}}x\right) + Ecos\left(\sqrt{\frac{\omega}{c}}x\right) + Ksin\left(\sqrt{\frac{\omega}{c}}x\right)$$

The constants A, B, C, D, E, K were obtained by using limiting conditions. Finally it was found that the eigenmodes are determined by the following equation:

$$Ch\left(\sqrt{\frac{\omega_i}{c}}R\right).\cos\left(\sqrt{\frac{\omega_i}{c}}R\right) = -1$$; c is defined as $c^2 = EI_z/\mu_m$

The following solutions were found for the eigen frequencies: N_0=12.2544 Hz; N_1= 76.7954 Hz; N_2=215.075 Hz; N_3=421.3398 Hz; N_4=696.5578 Hz. V(x,t) was also calculated for each eigenmode.

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P23
SYNTHESIS OF FUNCTIONAL ORGANIC MATERIALS BASED ON TTF FOR OPTOELECTRONIC DEVICES

Louiza Boudiba,* Sameh Boudiba, Hayet Douib, Abdelkrim Gouasmia

Laboratory of organic materials and heterochemistry, University of Tebessa, 12000 Tebessa, Algeria,
lboudiba@gmail.com

Tetrathiafulvalene (TTF) are one of the major components of synthetic metals which exhibit electroconductivity over a wide range, from semi-conductors to superconductors. By combining the well-known electron transport properties of tetrathiafulvalene (TTF) with the metal-binding ability of pyridine ligands, we expect to obtain metal complexes with different physical properties.

The synthesis of materials showing synergy between electrical conductivity and magnetic interactions is a subject of intensive and recent studies. Many photovoltaic (solar) cells are relying on photoactivated elecron transfer between a conjugated polymer and a metal transition complex. The generation of charge carries, in the polymer backbone, a high conductivity (photoconductivity).
In this context, we have synthesized new TTF molecules and project to prepare their corresponding materials.

P24

Reducing Energy Bills of Higher Education Institutions with Solar Energy

Pr César Kapseu [a] *; Dr Noel Djongyang* [b] *; Teukam Dabou* [c] *; Tientcheu Maxwell* [d] *; Njukouyou Ibrahim* [e] *; Eyono Fabrice* [f].

[a] ENSAI-Université de Ngaoundéré.[b] département de Physique ; Faculté des sciences ; Université de Ngaoundéré. [c ; d ; e ; f] Ingénierie des équipements Agro-industrielles; ENSAI-Université de Ngaoundéré. kapseu@yahoo.fr; anitokou@yahoo.fr

Central Africa has great potential insolation (World Solar Atlas 2006), and Cameroon in the heart does not deprive them of this radiation. The main sources of power generation in the country is hydro and thermal power plants, both of them are expensive in the production of electricity, transportation and even more for the environment. But, solar energy unlike other is free with no adverse effect on the environment, and in some areas like the Far North of Cameroon can be available all year long. Our model is an institution in the Adamawa region, specifically in the town of Ngaoundere and extrapolations with appropriate sizing fact, can be applied to other institutions. With a sunshine of 4.6 kWh / (m² day) and estimated needs to 968.397 kWh / day. Calculations have shown that we would need around 3162 solar panels for the recovery of electric power facility. By attaching other devices such as batteries, accumulators, regulators, cables etc. ...., the overall investment cost is 766 507 424 F CFA, that included their origin, manufacturing technology and workmanship. A simulation shows that after 9 years the investment is amortized. After this the main activity remain the maintenance of panels. Institutions of higher education can greatly benefit to invest in solar energy, because after the return of investment they still have 21 years of free of charge power supply or a gain of 1 835 946 147 F CFA francs.

Keywords: level institution, sizing, solar panel, batteries, solar energy.

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Design of an Electronics Power and Charge Controller for Hybrid Energy Systems (EPCCHES)

André Rodrigue Tchamda,[a,b] *Robert Tchitnga**,[a] *Christian Tchapga Tchito*,[a] *Martin Kom*[b]

[a]*Research Group on Experimental and Applied Physics for Sustainable Development, Physics Department, the University of Dschang, Cameroon;* [b]*Groupe de Recherche sur les Technologies Médicales Adaptées aux Tropiques, Laboratoire d'Electronique et de Traitement du Signal, Département des Génies Electrique et Télécommunications, ENSP, Université de Yaoundé I, Cameroon.**E-mail address: tchitnga@yahoo.fr

The increasing use of renewable energy sources such as the sun (thermal or photovoltaic) and the wind (wind turbines) to produce the electrical power encourages the design of electrical modules helping in the storage of electrical power. To exploit different sources of electrical energy (solar, wind, diesel) in a single device, electronic hybrid modules have been developed for energy management system. Most of such hybrid modules can control and manage the charging process of batteries connected to an available sources power (plates voltaic, wind, diesel), or they can supply the electrical loads from the available generators (voltaic plates, wind, batteries, diesel generator). What lacks till now is a system for monitoring the power and not just the voltage. For if the total power of different receivers connected to the module is greater than the power source can provide, there will be a drop in the voltage. To overcome this problem, we propose an electronic module which, in addition to the functions of other modules already available on the market such as voltage control, does also play the role of power controller.
Using a keyboard, the value of the power P_s that the source can provide will be preset at the start of the module and then it will be saved in eeprom of the microcontroller. Thus, the microcontroller can calculate the electrical efficiency η by the relation:

$$\eta = \frac{P_a}{P_s}$$

P_a being the power absorbed by the loads and P_s , the power at the source. We will consider the efficiency as control parameter to see if there is good demand for power. Thus, the efficiency threshold is 0.95 that is to say that the module will allow 95% of the power source to be available for the load. The remaining 5% will help to keep $P_s > P_a$. If $\eta > 0.95$ an alert will be triggered by the microcontroller using a buzzer, then the source will be disconnected from the power grid of the house. By using a NOKIA 3310 LCD type, the module will display the reason for the power failure.