



**E-MRS – IUMRS – ICEM 2000**



## **SYMPOSIUM N**

### **Thin Film Chalcogenide Photovoltaic Materials**

May 30 – June 2, 2000

#### **Symposium Organizers:**

**Robert BIRKMIRE**, Institute for Energy Conversion, Newark, USA

**Daniel LINCOT**, Ecole Nationale Supérieure de Chimie de Paris, France

**David CAHEN**, Weizmann Institute of Science, Rehovot, Israel

**Hans Werner SCHOCK**, University of Stuttgart, Germany

**Makoto KONAGAI**, Tokyo Institute of Technology, Japan

Symposium support:

**Programme de Recherche Interdisciplinaire sur les Technologies pour  
l'Écodéveloppement (ECODEV-CNRS)**

Papers will be published in Thin Solid Films

# E-MRS 2000 SPRING MEETING

## SYMPOSIUM N

Tuesday May 30, 2000

Mardi 30 mai 2000

Morning

Matin

### Session I - High Efficient Single Cells

Chairperson : M. Konagai

- N-I.1** 9:00 **Invited** MICROSTRUCTURAL PROPERTIES OF Cu(In,Ga)Se<sub>2</sub> THIN FILMS USED IN HIGH EFFICIENCY DEVICES, F. Hasoon, H. Althani, J. Alleman, M. Al-Jassim and **R. Noufi**, National Renewable Energy Laboratory, 1617 Cole Blvd., Golden CO 80401, USA
- N-I.2** 9:30 **Invited** OPTICAL AND ELECTRICAL CHARACTERIZATIONS OF HIGHLY EFFICIENT CdTe THIN FILM SOLAR CELLS, **T. Okamoto**, A. Yamada and M. Konagai, Tokyo Institute of Technology, 2-12-1 O-okayama, Meguro-ku, Tokyo 152-8552, Japan
- N-I.3** 10:00 BACK SURFACE BAND GAP GRADINGS IN Cu(In,Ga) Se<sub>2</sub> SOLAR CELLS, T. Dullweber, U. Rau, H.W. Schock, J. H. Werner, Institut für Physikalische Elektronik, Pfaffenwaldring 47, 70569 Stuttgart, Germany, O. Lundberg, M. Bodegård, L. Stolt, Ångström Solar Center, Uppsala University, P.O. Box 534, 751 21 Uppsala, Sweden
- N-I.4** 10:20 FORMATION AND ANALYSIS OF GRADED CuIn(Se,S)<sub>2</sub> FILMS, R.W. Birkmire, B.E. McCandless and M. Engelmann, Institute of Energy Conversion, University of Delaware, Newark, Delaware 19716, USA
- 10:40 **BREAK**

### Session II - Synthesis: Absorbers, Windows

Chairperson : C.H. Champness

- N-II.1** 11:00 LIFT-OFF PROCESSES FOR THE DEVELOPMENT OF FLEXIBLE AND LIGHTWEIGHT Cu(In,Ga) Se<sub>2</sub> SOLAR CELLS, D. Rudmann, F.-J. Haug, M. Krejci, H. Zogg, A.N. Tiwari, Thin Film Physics Group, Institute of Quantum Electronics, ETH (Swiss Fed. Inst. of Tech.), Technoparkstr. 1, 8005 Zürich, Switzerland
- N-II.2** 11:20 **Invited** THIN-FILM CIS ALLOY PV MATERIALS FABRICATED USING NON-VACUUM, PARTICLES-BASED TECHNIQUES, **C. Eberspacher**, C. Fredric, K. Pauls and J. Serra, Unisun, Research and Development, 587-F North Ventu Park Road, PMB 124, Newbury Park Ca 91320, USA
- N-II.3** 11:40 ELECTRICAL PROPERTIES OF N-TYPE CuGaSe<sub>2</sub>, J.H. Schoen and E. Bucher, Universität Konstanz, Fakultät fuer Physik, Postfach X916, 78457 Konstanz, Germany ; Bell Laboratories, Lucent Technologies, Murray Hill, NJ 07974-0636, USA
- N-II.4** 12:00 SOLAR CELL WITH EXTREMELY THIN ABSORBER BASED ON CdTe AND CuInS<sub>2</sub>, K. Ernst, I. Kaiser, R. Engelhardt, M. C. Lux-Steiner and R. Könenkamp, Hahn-Meitner Institut Berlin, Glienicker Str. 100, 14109 Berlin, Germany
- N-II.5** 12:20 NOVEL POSSIBILITIES FOR THIN FILM SOLAS CELLS BY ILGAR, Ch.-H. Fischer, H.-J. Muffler, M. Bär, M. Ch. Lux-Steiner, Hahn-Meitner-Institut, SE1, Glienicker Str. 100, 14109 Berlin, Germany
- 12:40 **LUNCH**

**Tuesday May 30, 2000**  
Mardi 30 mai 2000

**Afternoon**

Après-midi

14:00 **Poster session I**  
**Synthesis: Absorbers**

- N/PI.1** SODIUM CO-EVAPORATION FOR LOW TEMPERATURE CIGS DEPOSITION, M. Lammer, U. Klemm and M. Powalla, Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg, Hessbruehlstr. 21c, 70565 Stuttgart, Germany
- N/PI.2** CONTINUOUS CIGS DEPOSITION ON 30 CM x 30 CM SUBSTRATES, G. Voorwinden and M. Powalla, Zentrum fuer Sonnenenergie- und Wasserstoff-Forschung Baden-Wuerttemberg, Hessbruehlstr. 21c, 70565 Stuttgart, Germany
- N/PI.3** GROWTH AND CHARACTERIZATION OF (110)-ORIENTED EPITAXIAL Cu(In,Ga)Se<sub>2</sub> ON GaAs(110), Dong Xiang Liao, University of Illinois, Department of Materials Science and Engineering, 168 Engineering Sciences Building, 1101 W. Springfield Ave., Urbana IL 61801, USA, A. Rockett, U.S. Department of Energy, Office of Basic Energy Sciences, SC-13, 19901 Germantown Road, Germantown MD 20874-1290, USA
- N/PI.4** INFLUENCE OF SELENIZATION TECHNIQUES ON THE REACTION KINETICS OF CHALCOPYRITE THIN FILMS, W.J. Bekker and V. Alberts, Department of Physics, Rand Afrikaans University, PO Box 524, Aucklandpark, South Africa, M.J. Witcomb, Electron Microscope Unit, University of the Witwatersrand, Private bag 3, WITS 2006, South Africa
- N/PI.5** PHASE SEPARATION AND COMPOSITIONAL CHANGES IN TWO-STAGE PROCESSED CHALCOPYRITE THIN FILMS, V. Alberts, Department of Physics, Rand Afrikaans University, PO Box 524, South Africa, M. Klenk and E. Bucher, Department of Physics, University of Konstanz, PO Box X916, 78457 Konstanz, Germany
- N/PI.6** PROCESSING OF CuInSe<sub>2</sub> BY PULSED ELECTRON BEAM, S. Malkov, Institute of Applied Physics, Academiei str, 1, Kishinev 2028 Moldova
- N/PI.7** PROPERTIES OF FLASH EVAPORATED CHALCOPYRITE ABSORBER FILMS AND SOLAR CELLS, M. Klenk, O. Schenker, E. Bucher, Universität Konstanz, Fakultät für Physik, Fach X916, 78457 Konstanz, Germany and V. Alberts, Rand Afrikaans University, Auckland Park 2006, Johannesburg, South Africa
- N/PI.8** INFLUENCE OF THE GROWTH AND POST DEPOSITION TREATMENTS IN THE PROPERTIES OF CdTe THIN FIMS DEPOSITED BY CSVT, G. Contreras-Puente, J.Vidal-Larramendi\*, O. Vigil-Galan\*, F. Cruz-Gandarilla, C. Mejia-Garcia, P. De Gante-Cruz, M. Hesequio-Garduño, Escuela Superior de Fisica y Matematicas del I.P.N., 07738, México, D.F, México; O. Zelaya-Angel, A. Cruz-Orea, A.Hernandez-Guevara, Departamento de Fisica, Cinvestav-IPN, 07000 México D.F., México, \*Permanent address: Facultad de Fisica-IMRE, Universidad de la Habana, 43100 La Habana, Cuba
- N/PI.9** ELECTRICAL AND PHYSICO-CHEMICAL CHARACTERISATIONS OF A CuIn(S<sub>x</sub>Se<sub>1-x</sub>)<sub>2</sub> THIN FILMS GROWN BY CSVT FOR PHOTOVOLTAIC APPLICATIONS, O. Tesson, A. Bonnet and M. Morsli, Université de Nantes, LPSE-FSTN, BP 92208, 44322 Nantes Cedex 03, France
- N/PI.10** PROPERTIES OF STACKED Cu/In/Se THIN FILMS, N. Benslim<sup>(1)</sup>, L. Béchiri<sup>(1)</sup>, M. Benabdeslem<sup>(1)</sup>, L. Mahdjoubi<sup>(1)</sup>, P. Cowache<sup>(2)</sup> and G.Nouet<sup>(3)</sup>, <sup>(1)</sup>LCCM Institut de Physique Université Badji Mokhtar-Annaba, BP 12, 23000 Sidi Amar, Algérie; <sup>(2)</sup>Laboratoire d'Electrochimie Analytique et Appliquée, URA CNRS 216, ENSCP, 11rue P. et M. Curie, 75231 Paris Cedex 05, France; <sup>(3)</sup>LERMAT ISMRa-Université, 6 Boulevard du Maréchal-Juin, 14032 Caen, France
- N/PI.11** GROWTH OF Cu(In,Ga)Se<sub>2</sub> FILMS USING ONE-STEP ELECTRODEPOSITION, A.M. Hermann, M. Mansour and P.A. Ramakrishnan, Department of Physics, University of Colorado at Boulder, Boulder CO 80309, USA
- N/PI.12** RECRYSTALLIZATION AND COMPONENTS REDISTRIBUTION PROCESSES IN ELECTRODEPOSITED CuInSe<sub>2</sub> THIN FILMS, C. Guillén and J. Herrero, Departamento de Energías Renovables (CIEMAT-DER), Avda. Complutense 22, 28040 Madrid, Spain

- N/PI.13** ELECTRODEPOSITION OF PHOTOACTIVE CuInSe<sub>2</sub> THIN FILMS BY THE INDUCED CO-DEPOSITION MECHANISM, M. Kemell, H. Saloniemä, M. Ritala and M. Leskeläe, Department of Chemistry, P.O.Box 55, University of Helsinki, 00014 Helsinki, Finland
- N/PI.14** SOLAR CELLS WITH FAST ELECTRODEPOSITED CADMIUM TELLURIDE: MATERIAL CHARACTERIZATION AND DEVICE OPTIMIZATION, C. Lepiller, J. F. Guillemoles, P. Cowache, D. Lincot, Ecole Nationale Supérieure de Chimie de Paris, 11 rue Pierre et Marie Curie, 75231 Paris cedex 05, France, M. Froment, UPR15 du CNRS, Université Pierre et Marie Curie, 75232 Paris cedex 05, France, P.N. Gibson, Institute for Health and Consumer Protection, Joint Research Centre of the European Commission, 21020 Ispra (VA), Italy, M.E. Özsan, BP Solar, 12 Brooklands Close, Sunbury, Middlesex. TW16 7DX, UK
- N/PI.15** EFFECT OF SODIUM ON BRIDGMAN-GROWN Cu(In<sub>1-x</sub>Ga<sub>x</sub>)<sub>3</sub>Se<sub>5</sub> CRYSTALLINE MATERIAL, H. P. Wang, I. Shih and C.H. Champness, Electrical and Computer Engineering Department, McGill University, 3480 University Street, Montreal, Quebec, H3A 2A7, Canada
- N/PI.16** CVD OF CuGaSe<sub>2</sub> FOR THIN FILM SOLAR CELLS EMPLOYING TWO BINARY SOURCES, D. Fischer, T. Dylla, N. Meyer, M.E. Beck, A. Jäger-Waldau, and M.Ch. Lux-Steiner, Hahn-Meitner-Institut Berlin, Glienicke Straße 100, 14109 Berlin, Germany
- N/PI.17** DOPANTS IN EPITAXIAL CuGaSe<sub>2</sub> GROWN BY MOVPE, A. Gerhard, W. Harneit, S. Brehme, A. Bauknecht, U. Fiedeler, S. Siebentritt and M.Ch. Lux-Steiner, Hahn-Meitner-Institut Berlin, Glienicke Straße 100, 14109 Berlin, Germany
- N/PI.18** INFLUENCE OF THE GA-CONTENT ON THE BULK DEFECT DENSITIES OF Cu(In,Ga)Se<sub>2</sub>, G. Hanna, A. Jasenek, U. Rau, and H.-W. Schock, Institut für Physikalische Elektronik, Pfaffenwaldring 47, 70569 Stuttgart, Germany
- N/PI.19** CuGaSe<sub>2</sub> – BASED SUPERSTRATE SOLAR CELLS, M. R. Balboul, A. Jasenek, O. Chernykh, U. Rau, and H. W. Schock, Institut für Physikalische Elektronik, Pfaffenwaldring 47, 70569 Stuttgart, Germany
- N/PI.20** ROLE OF Ga MIGRATION ON THE MICROSTRUCTURAL AND INTERFACE PROPERTIES OF Cu(In,Ga)Se<sub>2</sub>/ZnO SUPERSTRATE SOLAR CELLS, F.-J. Haug, M. Krejci, H. Zogg, A. N. Tiwari, Thin Films Physics Group, Institute of Quantum Electronics, ETH Zurich, Technoparkstr. 1, 8005 Zurich, Switzerland
- N/PI.21** CuInS<sub>2</sub> THIN FILMS FROM COEVAPORATED PRECURSORS, M. Gossila, H.-E. Mahnke, Hahn-Meitner Institut, Bereich Strukturforschung, Glienicke Str. 100, 14109 Berlin, Germany and H. Metzner, Institut für Festkörperphysik, Universität Jena, Max-Wien-Platz 1, 07743 Jena, Germany
- N/PI.22** CHEMICAL COMPOSITION OF CuInS<sub>2</sub> THIN FILMS PREPARED BY SPRAY PYROLYSIS, M. Krunk, O. Bijakina, I. Oja, E. Mellikov, Institute of Materials Technology, A. Mere, Institute of Physics, Tallinn Technical University, Ehitajate 5, 19086 Tallinn, Estonia
- N/PI.23** EFFECT OF SULFURIZATION ON THE MICROSTRUCTURE OF CIGS LAYERS, J. Keränen, J. Lu, J. Sterner, J. Kessler, L. Stolt, and E. Olsson, Ångström Solar Center, Uppsala University, P. O. Box 534, 751 21 Uppsala, Sweden
- N/PI.24** ORDER AND DISORDER IN EPITAXIALLY GROWN CuInS<sub>2</sub>, Th. Hahn, H. Metzner, Institut für Festkörperphysik, Universität Jena, Max-Wien-Platz 1, 07743 Jena, Germany and B.Plikat, M. Seibt, IV. Physikalisches Institut, Universität Göttingen, Bunsenstrasse 13-15, 37073 Göttingen, Germany
- N/PI.25** CISCUT-ABSORBER LAYERS - THE PRESENT MODEL OF THIN FILM GROWTH, M. Winkler<sup>(1)</sup>, O.Tober<sup>(1)</sup>, J. Penndorf<sup>(1)</sup>, J. Griesche<sup>(1)</sup>, K. Szulzewsky<sup>(2)</sup> and G. Lippold<sup>(3)</sup>, <sup>(1)</sup>Institut für Solartechnologien, Im Technologiepark 7, 15236 Frankfurt (Oder), Germany; <sup>(2)</sup>KELCH GbR, Breitscheidstr. 9, 16548 Glienicke, Germany; <sup>(3)</sup>Institut für Oberflächenmodifizierung e.V., Permoserstr. 15, 04318 Leipzig, Germany
- N/PI.26** THE INFLUENCE OF CdTe GROWTH AMBIENT ON MOCVD GROWN CdS/CdTe PHOTOVOLTAIC CELLS, A. Hartley and S.J.C. Irvine, North-East Wales Institute of Higher Education, Plas Coch, Mold Road, Wrexham, UK
- N/PI.27** AUGER AND XRD INVESTIGATIONS OF SULPHUR DIFFUSION AT THE CdS/CdTe INTERFACE, P.N. Gibson and M.A. Baker, EC-JRC, Institute for Health and Consumer Protection, 21020 Ispra (VA), Italy, and M.E. Özsan, BP Solarex, 12 Brooklands Close, Sunbury-on-Thames GU22 9AG, UK

- N/PI.28** LIQUID PHASE RECRYSTALLIZATION AND SINTERING OF CdTe, J. Hiie, Tallinn Technical University, Ehitajate tee 5, 19086 Tallinn, Estonia
- N/PI.29** CORRELATION OF CHEMICAL AND STRUCTURAL PARAMETERS WITH NON-UNIFORM CELL PERFORMANCE IN CdS/CdTe SOLAR CELLS, P.N. Gibson and E.D. Dunlop, EC-Joint Research Centre, 21020 Ispra (VA), Italy, M.E. Özsan, BP Solarex, 12 Brooklands Close, Sunbury-on-Thames GU22 9AG, UK and D. Lincot and M. Froment, ENSCP, 11 rue Pierre et Marie Curie, 75231 Paris Cedex 05, France
- N/PI.30** THE GROWTH OF PYRITE (FeS<sub>2</sub>) THIN FILMS INVESTIGATED BY THERMOELECTRIC MEASUREMENTS, J.R. Ares, I.J. Ferrer, F. Cuevas, C. Sanchez, Dpto de Fisica de Materiales, C-IV, Universidad Autonoma de Madrid, U.A.M., Cantoblanco, 28049 Madrid, Spain
- N/PI.31** ELECTRO/ELECTROLESS GROWN LOW COST PRECURSORS FOR CIGS PHOTOVOLTAIC CELLS, P.J. Sebastian<sup>(1)</sup>, M.E. Calixto<sup>(1)</sup>, M. Pattabi<sup>(1)</sup>, X. Mathew<sup>(1)</sup> and R.N. Bhattacharya<sup>(2)</sup>, <sup>(1)</sup>CIE-UNAM, 62580 Temixco, Morelos, Mexico, <sup>(2)</sup>NREL, 1617 Cole Blvd, Golden, Colorado, USA

15:30

**BREAK**

### Session III

**Chairperson : P. Bogus**

- N-III.1** 16:00 **Invited** CdS/CdTe SOLAR CELL DEVELOPMENT ACTIVITIES AT NREL, **T. Gessert**, R. Dhere, X. Wu, D. Albin, X. Li, and R. Ribelin, National Renewable Energy Laboratory, Golden (NREL), CO, USA
- N-III.2** 16:30 **Invited** Cu(In,Ga)Se<sub>2</sub> DEVICES: FROM CELLS TO MINI-MODULES, **J. Kessler**, M. Bodegård, J. Hedsröm and L. Stolt, Angström Solar Center, Uppsala University, P.O. Box 534, 751 21 Uppsala, Sweden
- 17:00-18:30 **Discussion session 1**  
***What makes stable high efficiency cells?***  
D. Cahen, T. Wada

Wednesday May 31, 2000  
Mercredi 31 mai 2000

Afternoon  
Après-midi

14:00                   **Poster session II**  
                              **Windows Synthesis, Cells & Theory**

- N/PII.1** INFLUENCE OF BUFFER LAYER AND TCO DEPOSITON ON THE BULK PROPERTIES OF CHALCOPYRITES, I. Luck, A. Ennaoui and D. Bräunig, Hahn-Meitner Institut, Glienicker Str. 100, 14109 Berlin, Germany and E. Terzini, ENEA, Via del Vecchio Macello, Portici 80055, Italy
- N/PII.2** CHARACTERISATION OF CuInS<sub>2</sub>/ZnSe JUNCTIONS BY XPS AND ELECTROREFLECTANCE, A.M.Chaparro, C.Maffiotte, M.T.Gutierrez and J.Herrero, Dep.Energias Renovables. CIEMAT. Avda.Complutense 22, 28040 Madrid, Spain; J. Klaer, K. Siemer and D. Braeunig, Abt.AT. Hahn Meitner Institut. Glienicker Str.100, 14109 Berlin, Germany
- N/PII.3** HETEROEPITAXY OF ELECTRODEPOSITED CdSe ON (100) InP AND GaAs SINGLE CRYSTALS, L. Beaunier, H. Cachet, R. Cortes, M. Froment, Physique des Liquides et Electrochimie, UPR 15 CNRS, Université Paris VI, 4 Place Jussieu, 75252 Paris Cedex 05, France, A. Etcheberry, Institut Lavoisier (IREM) UMR CNRS C0173, Université de Versailles-St Quentin en Yvelynes, 45 Avenue des Etats Unis, 78035 Versailles Cedex, France
- N/PII.4** REACTION MECHANISMS AND KINETICS FOR THE CHEMICAL BATH DEPOSITION OF In(OH)<sub>x</sub>S<sub>y</sub> THIN FILMS, R. Bayon and J. Herrero, Departamento de Energias Renovables (CIEMAT), Av. Complutense 22, 28040 Madrid, Spain
- N/PII.5** PROGRESS TOWARDS MODELLING THE CdS CHEMICAL BATH DEPOSITION PROCESS, M. Kostoglou, N. Andritsos and A.J. Karabelas, Department of Chemical Engineering, Aristotle University of Thessaloniki, and Chemical Process Engng Research Institute, P.O. Box 1517, 540 06 Thessaloniki, Greece
- N/PII.6** STRUCTURAL AND PHYSICAL PROPERTIES OF SPRAYED CADMIUM-ZINC OXIDE THIN FILMS, F.Cruz-Gandarilla, O.Vigil-Galan\*, G.Contreras-Puente, C.Mejia-Garcia, L.Vaillant, M. Hesequio-Garduño, E. Diaz-Valdés; Escuela Superior de Fisica y Matematicas del I.P.N., 07738 México, D.F, México; L.Vaillant, Facultad de Fisica-IMRE, Universidad de la Habana, 43100, La Habana, Cuba; \*Permanent address: Facultad de Fisica-IMRE, Universidad de la Habana, 43100 La Habana, Cuba
- N/PII.7** ZnSe BUFFER LAYER WITH THE GRADED BAND GAP FOR PHOTOELECTRICAL CONVERTERS BASED ON CuGaSe<sub>2</sub>, M. Rusu, P. Gashin, A. Simashkevich\*, Department of Physics, State University of Moldova, 60, A.Mateevich St., 2009 Chisinau, Moldova, \*Institute of Applied Physics, Moldova Academy of Science, 5, Academia St., 2028, Chisinau, Moldova
- N/PII.8** NOVEL BUFFER LAYERS FOR CHALCOPYRITE THIN FILM SOLAR CELLS, Yu.A. Nikolaev, Yu.V. Rud', E.I. Terukov, A.F. Ioffe Physicotechnical Institute, RAS, 194021 St.Petersburg, Russia and V.Yu. Rud', St.Petersburg State Technical University, 195251 St.Petersburg, Russia
- N/PII.9** Cd FREE BUFFER LAYER FOR THIN FILM SOLAR CELLS, N. Barreau, J.C. Bernède, S. Marsillac, Université de Nantes, LPSE FSTN, BP 92208, 44322 Nantes Cedex 3, France
- N/PII.10** ON THE DIFFICULTY TO OBTAIN I-III-VI<sub>2</sub> CHALCOPYRITE THIN FILMS CONTAINING ALUMINUM, J.C. Bernède, S. Marsillac, C. Ould El Moctar, Université de Nantes, LPSE FSTN, BP 92208, 44322 Nantes cedex 3, France, and K. Benchouk, A. Khelil, LPMCE, Université d'Oran Es-Sénia, Algeria
- N/PII.11** EVIDENCE OF PHOTOCONVERTER PROPERTIES OF a-Si:H/n-InSe HETEROCONTACTS, Yu.A. Nikolaev, Yu.V. Rud', E.I. Terukov, A.F. Ioffe Physicotechnical Institute, RAS, 194021 St.Petersburg, Russia and V.Yu. Rud', St.Petersburg State Technical University, 195251 St.Petersburg, Russia
- N/PII.12** DEVELOPMENT OF EFFICIENT AND STABLE BACK CONTACTS ON CdTe/CdS SOLAR CELLS, D.L. Baetzner, A. Romeo, H. Zogg, A.N. Tiwari, Thin Films Physics Group, Institute of Quantum Electronics, ETH (Swiss Federal Institute of Technology) Zurich, Technoparkstr. 1, 8005 Zurich, Switzerland

- N/PII.13** THE ROLE OF Cu IN CdTe/CdS SOLAR CELL INSTABILITY, K.D. Dobson, I. Visoly-Fisher, G. Hodes and D. Cahen, Department of Materials and Interfaces, Weizmann Institute of Science, Rehovot 76100, Israel
- N/PII.14** ELECTROLESS Ni AND NiTe<sub>2</sub> OHMIC CONTACTS FOR CdTe/CdS PV CELLS, O. Rotlevi, K. Dobson and G. Hodes, Department of Materials and Interfaces, Weizmann Institute of Science, Rehovot 76100, Israel
- N/PII.15** ROLE OF CONTACTS IN CHARACTERIZATION OF LOW-TEMPERATURE MECHANOSTIMULATED CHANGE OF CdTe CRYSTAL CONDUCTIVITY, M. Furtak, B. Pavlyk and V. Buratchek, Physical Department, Lviv Ivan Franko National University, Dragomanov Street 50, 79005, Lviv, Ukraine
- N/PII.16** BAND ALIGNMENT AT CDTE/CDS SOLAR CELLS : ORIENTATION DEPENDENCE OF THE HETEROINTERFACE ?, J. Fritsche, A.Klein, W. Jaegermann, Darmstadt University of Technology, Dept. of Materials Science, 64287 Darmstadt, Germany
- N/PII.17** SURFACE ANALYSIS OF CDTE THIN FILM SOLAR CELLS, J. Fritsche<sup>(1)</sup>, A. Klein<sup>(1)</sup>, R. Wendt<sup>(2)</sup>, R. Gegenwart<sup>(2)</sup>, and W. Jaegermann<sup>(1)</sup>, <sup>(1)</sup>Darmstadt University of Technology, Materials Science Division, Petersenstr.23, 64287 Darmstadt, Germany, <sup>(2)</sup>ANTEC GmbH, Industriestr. 2-4, 65779 Kelkheim, Germany
- N/PII.18** THEORETICAL STUDY OF THE Cd<sub>x</sub>Zn<sub>1-x</sub>Te AND Cd<sub>x</sub>Mn<sub>1-x</sub>Te ALLOYS, R. de Paiva, R.A. Nogueira, DF-ICEX-UFGM, CP 702, 30161-970 Belo Horizonte MG, Brazil, J.L.A. Alves, H.W. Leite Alves, DCNAT-FUNREI, CP 110, 36.300-000 Sao Joao del Rei MG, Brazil, L.M.R. Scolfaro and J.R. Leite, DFMM-IF-USP, CP 66.318, 05389-970 Sao Paulo SP, Brazil
- N/PII.19** PRECISE PREDICTION OF ELECTRICAL PROPERTIES OF NON-STOICHIOMETRIC COPPER INDIUM DISELENIDE BY THE METHOD OF MINIMIZING THE TOTAL DEFECT FORMATION ENERGY, H.H. Chang<sup>(1)</sup>, T.S. Tsong<sup>(1)</sup>, H.Y. Ueng<sup>(2)</sup> and H.L. Hwang<sup>(1)</sup>, Institute of Electronical Engineering, National Tsing Hua University, Hsinchu, Taiwan, R.O.C; <sup>(2)</sup>Department of Electrical Engineering, National Sun Yat-sen University, Kaohsiung, Taiwan, R.O.C.
- N/PII.20** THEORETICAL CHARACTERISTICS OF STRUCTURAL DEFECTS IN CuInSe<sub>2</sub>: MOLECULAR - STATIC MODELS. A.N.Varaksin, A.B.Sobolev, Department of Experimental Physics, Urals State Technical University, Ekaterinburg, Russia, A.V.Postnikov: Institute of Metal Physics, Russian Academy of Sciences, S.Kowalewskoj 18, Ekaterinburg, Russia, M.V.Yakushev, R.D.Pilkington, A.E.Hill, R.D.Tomlinson, Photonic Centre, Joule Physics Laboratory, Salford University M5 4WT, UK
- N/PII.21** EFFECT OF SUBSTITUTION OF In BY Ga, Al IN CuInSe<sub>2</sub> ELECTRON SPECTRUM, B. Lukiyanets, R. Hoy, The State Univeristy "Lvivska Politeknika", 12 Bandera Str., 79013 Lviv, Ukraine
- N/PII.22** OPTIMISATION OF CIS CuT CELL DESIGN, J. Wienke et al., Netherlands Energy Research Foundation ECN, Solar Energy, P.O. Box 1, 1755 ZG Petten, The Netherlands, and M. Burgelman et al., University of Gent, Electronics and Information Systems (ELIS), Pietersnieuwstraat 41, 9000 Gent, Belgium
- N/PII.23** 9.2. % EFFICIENT CuInS<sub>2</sub> MINI-MODULE, J. Klaer, K. Siemer, I. Luck and D. Bräunig, Hahn-Meitner Institut, Glienicke Str. 100, 14109 Berlin, Germany
- N/PII.24** SIGNIFICANT CHARACTERISATION ISSUES OF CdTe MODULES, G. Agostinelli<sup>(1)</sup>, W. Zaaïman<sup>(1)</sup>, T. Sample<sup>(1)</sup>, R. Wendt<sup>(2)</sup> and E.D. Dunlop<sup>(1)</sup>, <sup>(1)</sup>Renewable Energies unit, EC DJ JRC, TP 450, via e. Fermi 1, 21020 Ispra, Italy; <sup>(2)</sup>ANTEC GmbH, Industriestr. 2-4, 65779 Kelkheim, Germany
- N/PII.25** ELECTROCHEMICAL APPROACH FOR REMOVAL, SEPARATION AND RETRIEVAL OF CdTe AND CdS FILMS FROM WASTE PV DEVICES, S. Menezes, InterPhases Research, PO Box 1532, Thousand Oaks CA 91360, USA

**N/PII.26** CHEMICAL BATH DEPOSITION OF CdS BUFFER LAYER PROSPECTS IN INCREASING MATERIALS YIELD AND REDUCING WASTE, D. Hariskos<sup>(1)</sup>, M. Powalla<sup>(1)</sup>, N. Chevaldonnet<sup>(2)</sup>, D. Lincot<sup>(2)</sup>, A. Schindler<sup>(3)</sup>, B. Dimmler<sup>(3)</sup>, <sup>(1)</sup>Zentrum für Sonnenenergie- und Wasserstoff-Forschung, Hessbruehlstr. 21c, 70565 Stuttgart, Germany, <sup>(2)</sup>Ecole Nationale Supérieure de Chimie de Paris, rue Pierre et Marie Curie 11, 75231 Paris Cedex 05, France, <sup>(3)</sup>Würth Solar, Ludwigsburgerstr. 100, 71672 Marbach A. N., Germany

**N/PII.27** ELECTROCHEMICAL TREATMENT OF CuInSe<sub>2</sub>, U. Störkel, M. Aggour, C. Murrell, H. Lewerenz, Hahn Meitner Institute Berlin, Department for Solar Energy, Glienecker Strasse 100, 14109 Berlin, Germany

15:30            **BREAK**

#### **Session IV**

**Chairperson : M.E. Öszan**

**N-IV.1** 16:00            INTERFACIAL ENGINEERING OF CIGS THIN FILM SOLAR CELLS BASED ON ATOMIC LAYER EPITAXY, D. Lincot, E.B. Yousfi, B. Canava, J. F. Guillemoles, P. Cowache, Ecole Nationale Supérieure de Chimie de Paris, 11 rue Pierre et Marie Curie, 75231 Paris cedex 05, France, H. Schock, Institute für Physikalische Elektronik, University Stuttgart, Germany, D. Hariskos, M. Powalla, Zentrum für Solarenergie and Wasserstoffforschung, Hessbruehlstr. 21c, 70565, Stuttgart, Germany

**N-IV.2** 16:30 **Invited**    CHARACTERIZATION OF Cu(In,Ga)Se<sub>2</sub>/Mo INTERFACE IN CIGS SOLAR CELLS, **T. Wada**, Department of Materials Chemistry, Ryukoku University, Seta, Otsu 520-2194, Japan, N. Kohara, S. Nishiwaki And T. Negami, Advanced Technology Research Laboratories, Matsushita Electric Ind.Co., Ltd., 3-4 Hikaridai, Seika-cho, Soraku-gun, Kyoto 619-0237, Japan

17:00-18:30        **Discussion session 2**  
**Synthesis Methods:**  
**Material quality vs costs and scalability**  
C. Eberspacher, L.Stolt/M. Bodegard

**Thursday June 1, 2000**

Jeudi 1<sup>er</sup> juin 2000

**Morning**

**Matin**

**Session V**

**N-V.1** 9:00 **Invited** PROCESS DEVELOPMENT OF HIGH PERFORMANCE CIGS MODULES FOR MASS PRODUCTION, **M. Powalla**, Zentrum für Sonnenenergie- und Wasserstoff-Forschung (ZSW), Hessbrühlstrasse 21C, 70565 Stuttgart, Germany and B. Dimmler, Würth Solar GmbH & Co. KG, Ludwigsburger Strasse 100, 71672 Marbach am Neckar, Germany

**N-V.2** 9:30 **Invited** IMPROVEMENT OF ELECTRICAL YIELD IN THE FABRICATION OF CIGS-BASED THIN-FILM MODULES, **K. Kushiya**, Showa Shell Sekiyu K.K., Central R&D Lab (ARL), 123-1, Shimo-kawairi, Atsugi, Kanagawa, Japan

**N-V.3** 10:00 **Invited** RAPID CIS- PROCESS FOR HIGH EFFICIENCY PV- MODULES: DEVELOPMENT TOWARDS LARGE AREA PROCESSING, **V. Probst**<sup>(1)</sup>, W. Stetter<sup>(1)</sup>, W. Riedl<sup>(1)</sup>, H. Vogt<sup>(2)</sup>, M. Wendl<sup>(1)</sup>, H. Calwer<sup>(2)</sup>, S. Zweigart<sup>(1)</sup>, K.-D. Ufert<sup>(2)</sup>, B. Freienstein<sup>(1)</sup> and F.H. Karg<sup>(2)</sup>, <sup>(1)</sup>Siemens AG, Corporate Technology, Otto-Hahn-Ring 6, 81739 Munich, Germany, <sup>(2)</sup>Siemens Solar GmbH

10:30 **BREAK**

**Session VI - Characterization**

**Chairperson : R. Triboulet**

**N-VI.1** 10:50 **Invited** IMPURITY DOPING AND COMPENSATION MECHANISMS IN CdTe, **Y. Marfaing**, LPSC-CNRS, 92195 Meudon Cedex, France

**N-VI.2** 11:10 ANALYSIS OF THE SECOND JUNCTION AT THE BACK CONTACT OF CDS/CDTE SOLAR CELLS, **S. Oktik**<sup>(1)</sup>, M. E. Özsan<sup>(2)</sup>, <sup>(1)</sup>Mugla University, Department of Physics, 48000 Mugla, Turkey, <sup>(2)</sup>BP Solarex, Unit 12, Brooklands Close, Sunbury on Thames, Middlesex TW16 7DX, UK

**N-VI.3** 11:30 EFFECTS OF ORGANIC MOLECULE ADSORPTION ON CdTe-BASED THIN FILM SOLAR CELLS, **I. Visoly-Fisher**, S. Cohen & D. Cahen, Weizmann Inst. of Science, Rehovot, Israel

**N-VI.4** 11:50 STUDIES OF SULFUR PASSIVATION ON Sb-INCOPORATED CuInSe<sub>2</sub> THIN FILMS USING EXAFS AND ADXRF, **Y.H. Cheng**<sup>(1)</sup>, Yun-Liang Soo<sup>(2)</sup>, B.H. Tseng<sup>(3)</sup>, Yi-Han Kao<sup>(2)</sup> and H.L. Hwang<sup>(1)</sup>; <sup>(1)</sup>Department of Electrical Engineering, National Tsing Hua University, Hsinchu, Taiwan, R.O.C.; <sup>(2)</sup>Department of Physics, State University of New York at Buffalo, Buffalo NY14261, USA; <sup>(3)</sup>Institute of Material Science and Engineering, National Sun Yat Sen University, Kaoshiung, Taiwan, R.O.C.

**N-VI.5** 12:10 **Invited** ANION VACANCIES IN CuInSe<sub>2</sub>, **S. Niki**, R. Suzuki, T. Ohdaira, S. Ishibashi, P. J. Fons, A. Yamada, and H. Oyanagi, Electrotechnical Laboratory, 1-1-4 Umezono, Tsukuba, Ibaraki 305, Japan

12:40 **LUNCH**

Thursday June 1, 2000

Afternoon

Jeudi 1<sup>er</sup> juin 2000

Après

14:00 **Poster session III**  
**Characterization**

- N/PIII.1** SPECTROSCOPIC INVESTIGATION OF BURIED INTERFACES IN Cu(In,Ga)(S,Se)<sub>2</sub>-BASED SOLAR CELLS, C. Heske<sup>(1)</sup>, U. Groh<sup>(1)</sup>, D. Eich<sup>(1)</sup>, R. Fink<sup>(1)</sup>, E. Umbach<sup>(1)</sup>, A. Ennaoui<sup>(2)</sup>, H.-J. Muffler<sup>(2)</sup>, Ch.-H. Fischer<sup>(2)</sup>, M.C. Lux-Steiner<sup>(2)</sup>, W. Riedl<sup>(3)</sup>, and F. Karg<sup>(4)</sup>, <sup>(1)</sup>Experimentelle Physik II, Universitaet Wuerzburg, 97074 Wuerzburg, <sup>(2)</sup>Hahn-Meitner-Institut, 14109 Berlin, <sup>(3)</sup>Siemens AG and <sup>(4)</sup>Siemens Solar GmbH, 80807 Muenchen, Germany
- N/PIII.2** CROSS-SECTIONAL ATOMIC FORCE AND ELECTROSTATIC FORCE MICROSCOPY OF THIN FILM SOLAR CELL, C. Ballif, H.R. Moutinho, R.G. Dhere, F.S. Hasoon, M.M. Al-Jassim, National Renewable Energy Laboratory, Golden Co 80401, USA
- N/PIII.3** IN SITU XPS INVESTIGATIONS OF ION BEAM HYDROGENATION OF CuInSe<sub>2</sub> SINGLE CRYSTAL SURFACES, K. Otte<sup>(1)</sup>, G. Lippold<sup>(1)</sup>, D. Hirsch<sup>(1)</sup>, A. Schindler<sup>(1)</sup>, M. V. Yakushev<sup>(2)</sup>, F. Bigl<sup>(1)</sup>; <sup>(1)</sup>Institute for Surface Modification, Permoserstr. 15, 04318 Leipzig, Germany; <sup>(2)</sup>Department of Physics, University of Salford, Salford M5 4WT, UK
- N/PIII.4** A COMPARATIVE EBIC STUDY OF CdTe SOLAR CELL ACTIVATION USING CdCl<sub>2</sub> AND Cl<sub>2</sub>, P. R. Edwards and K. Durose, Department of Physics, University of Durham, South Road, Durham, DH1 3LE, UK, J.Beier and D.Bonnet, ANTEC GmbH, Industriestraße 2-4, 65779 Kelkheim, Germany
- N/PIII.5** INFLUENCE OF COPPER AND OXYGEN ON THE OPTOELECTRONIC PROPERTIES OF CHLORINE DOPED CdTe THIN FILMS, V. Valdna, Tallinn Technical University, 5 Ehitajate Road, 19086 Tallinn, Estonia
- N/PIII.6** DISSOLUTION OF Na IN CdTe AT 400°C, M. Altosaar, P.-E. Kukk and J. Raudoja, Tallinn Technical University, Ehitajate tee 5, 19086 Tallinn, Estonia
- N/PIII.7** PHOTOLUMINESCENCE AND THE TETRAGONAL DISTORTION IN CuInS<sub>2</sub>, J. Krustok, J. Raudoja, Tallinn Technical University, Ehitajate tee 5, Tallinn, Estonia, H. Collan, Optoelectronics Laboratory, Helsinki University of Technology, P.O.Box 3000, 02015 HUT, Finland
- N/PIII.8** PHOTOLUMINESCENCE STUDY OF CuGaSe<sub>2</sub> THIN FILMS GROWN BY MOCVD, G. Orsal, F. Mailly, M.C. Artaud and S. Duchemin, Centre d'Electronique et de Microoptoelectronique de Montpellier, C.N.R.S UMR 5507, Université Montpellier II, 34095 Montpellier Cedex 05, France
- N/PIII.9** CHARACTERIZATION OF POLYCRYSTALLINE CuInSe<sub>2</sub>/Si(100) THIN FILMS BY PHOTOLUMINESCENCE, L. Béchiri<sup>(1)</sup>, M. Benabdeslem<sup>(1)</sup>, N. Benslim<sup>(1)</sup>, L. Mahdjoubi<sup>(1)</sup>, R.Madelon<sup>(2)</sup> and G.Nouet<sup>(2)</sup>; <sup>(1)</sup>LCCM Institut de Physique Université de Annaba, BP 12, 23200 Sidi Amar, Algérie; <sup>(2)</sup>LERMAT ISMRa-Université, 6 Boulevard du Maréchal-Juin, 14032 Caen, France
- N/PIII.10** EFFECTS OF DEUTERIUM IMPLANTATION ON THE OPTICAL PROPERTIES OF CuInGaSe/CdS THIN FILMS, M.V.Yakushev<sup>(1)</sup>, R.W.Martin<sup>(2)</sup>, J.Krustok<sup>(3)</sup>, H.W.Schock<sup>(4)</sup>, D. Holman<sup>(1)</sup>, R.D.Pilkington<sup>(1)</sup>, A.E.Hill<sup>(1)</sup>, R.D.Tomlinson<sup>(1)</sup>; <sup>(1)</sup>Physics Department, Salford University, M5 4WT, UK; <sup>(2)</sup>Physics Department, Strathclyde University, Glasgow, UK; <sup>(3)</sup>Tallinn Technical University, Ehitajate tee 5, Tallinn, Estonia; <sup>(4)</sup>Institut fuer Physikalische Elektronik, Universitaet Stuttgart, Germany
- N/PIII.11** OPTICAL PROPERTIES OF CuIn<sub>3</sub>Se<sub>5</sub> WITH STOICHIOMETRIC DEVIATIONS, R. Diaz, H. Charbonnier, J.M. Merino and M. Leon, Universidad Autonoma de Madrid, Departamento Fisica Aplicada C-XII, 28049 Madrid, Spain
- N/PIII.12** PHOTOACOUSTIC SPECTROSCOPY OF SPRAYED CuGaInSe<sub>2</sub> THIN FILMS, R.B.V.Chalapathy<sup>(1)</sup>, K.T.Ramakrishna Reddy<sup>(1)</sup>, M.A.Slifkin<sup>(2)</sup>, A.Weiss<sup>(2)</sup> and R.W.Miles<sup>(3)</sup>, <sup>(1)</sup>Department of Physics, Sri Venkateswara University, Tirupati - 517 502, India ; <sup>(2)</sup>Department of Electronics,Jerusalem College of Technology, Jerusalem 91160, Israel ; <sup>(3)</sup>School of Engineering, University of Northumbria, Newcastle upon Tyne, NE1 8ST, UK

- N/PIII.13** INFRARED REFLECTIVITY OF  $\text{CuAlSe}_2$  and  $\text{CuAlTe}_2$  POLYCRYSTALLINE THIN FILM COMPOUNDS, C. Ould El Moctar, J.C. Bernede, S. Marsillac, LPSE, FSTN, BP92208, 44322 Nantes cedex 3, France, K. Benchouk, LPMCE, Université d'Oran Essénia, Algeria, K. Kambas and A. Anagnostopoulos, Physics Department, Aristotle University of Thessaloniki, Greece
- N/PIII.14** REFLECTANCE AND PHOTOLUMINESCENCE CHARACTERIZATION OF CdS AND CdSe HETEROEPITAXIAL FILMS DEPOSITED BY LASER ABLATION TECHNIQUE, G. Perna<sup>(1)</sup>, V. Capozzi<sup>(2)</sup>, S. Pagliara<sup>(3)</sup>; <sup>(1)</sup>Dipartimento di Fisica dell'Università di Bari and Istituto Nazionale di Fisica della Materia, Via Amendola 173, 70126 Bari, Italy ; <sup>(2)</sup>Facoltà di Medicina e Chirurgia dell'Università di Foggia and Istituto Nazionale di Fisica della Materia, Via Amendola 173, 70126 Bari, Italy, <sup>(3)</sup>Laboratorio di Strutturistica Chimica dell'Università di Brescia, Via Branze 38, 25123 Brescia, Italy
- N/PIII.15** CRYSTALLITE AND INTERFACE REGION PROPERTIES INFLUENCE ON CdSe LAYER PHOTOCONDUCTIVITY. R.Jasinskaite, V.Kazlauskienė, J.Sinius, J.Vaitkus, A.Zindulis, Dept. of Materials Research, Institute of Materials Science and Applied Research, Vilnius Univ., Sauletekio al.9-III, 2040 Vilnius, Lithuania
- N/PIII.16** AN X-RAY PHOTOELECTRON DIFFRACTION STUDY OF  $\text{CuInSe}_2$  SINGLE CRYSTALS, M.V.Kuznetsov, E.V.Shalaeva, Solid State Chemistry Institute, Russian Academy of Science, Ekaterinburg, Russia; M.V.Yakushev, R.D.Pilkington, A.E.Hill, R.D.Tomlinson, Photonic Centre, Joule Physics Laboratory, Salford University, M5 4WT, UK
- N/PIII.17** RAMAN SCATTERING STRUCTURAL EVALUATION OF  $\text{CuInS}_2$  THIN FILMS, J.Alvarez-Garcia, A.Pérez-Rodríguez, A.Romano-Rodríguez, T.Jawhari, J.R.Morante, EME, Universitat de Barcelona, 08028 Barcelona, Spain, R. Scheer, A. Neisser, Hahn Meitner Institute, 14109 Berlin, Germany
- N/PIII.18** MICROSTRUCTURAL CHARACTERISATION OF  $\text{CuInS}_2$  POLYCRYSTALLINE FILMS SULPHURISED BY RAPID THERMAL PROCESSING (RTP), J. Alvarez-Garcia, A. Pérez-Rodríguez, A. Romano-Rodríguez, L. Calvo-Barrio, J.R. Morante, EME, Universitat de Barcelona, 08028 Barcelona, Spain, K. Siemer, I. Luck, R. Klenk, Hahn Meitner Institute, 14109 Berlin, Germany
- N/PIII.19** THE NATURE OF THE PHOTOVOLTAIC EFFECT IN CRYSTALS OF THE In-Se SYSTEM AND OF THE In-Se SYSTEM WITH COOPER, D.M. Bercha, M. Sznajder, Pedagogical University, Rejtana 16a, 35-310 Rzeszow, Poland and L.Yu. Kharkhalis, K.Z. Rushchanskii, Uzhgorod State University, Uzhgorod, Ukraine
- N/PIII.20** DLTS STUDY OF  $\text{CuInS}_2$  SOLAR CELLS, K. Siemer, J. Klaer, I. Luck and D. Bräunig, Hahn-Meitner Institut, Glienicker Str. 100, 14109 Berlin, Germany
- N/PIII.21** ELECTRICAL CHARACTERIZATION OF  $\text{ZnO/CdS/Cu(In,Ga)Se}_2$  DEVICES WITH CONTROLLED SODIUM CONTENT, M. Igalson, A. Kubiacyk, P. Zabierowski, Faculty of Physics, Warsaw University of Technology, Koszykowa 75, 00-662 Warszawa, Poland and M. Bodegard, K. Granath, Angstrom Solar Center, Uppsala University, P.O. Box 534, 75121 Uppsala, Sweden
- N/PIII.22** RADIATION RESISTANCE OF  $\text{Cu(In,Ga)Se}_2$  SOLAR CELLS UNDER 1 MEV ELECTRON IRRADIATION, A. Jasenek, U. Rau, K. Weinert, T. Hahn, H.W. Schock, and J.H. Werner, Institut für Physikalische Elektronik, Pfaffenwaldring 47, 70569 Stuttgart, Germany
- N/PIII.23** METASTABILITIES IN  $\text{CuGaSe}_2$  THIN FILMS AND SOLAR CELLS, O. Schenker, M. Klenk, D. Reinke and E. Bucher, Universitaet Konstanz, Fakultät fuer Physik, Fach X916, 78457 Konstanz, Germany
- N/PIII.24** ELECTRICAL CHARACTERISATION OF DEFECTS IN  $\text{Cu(In,Ga)Se}_2$  SOLAR CELLS, M. Munzel, C. Deibel, V. Dyakonov, J. Parisi, University of Oldenburg, 26111 Oldenburg, Germany, W. Riedl, Siemens AG, 80807 Munich, Germany, F. Karg, Siemens Solar GmbH, 80807 Munich, Germany
- N/PIII.25**  $^{63}\text{Cu}$  NMR STUDIES OF  $\text{CuInS}_2$  AND  $\text{CuInSe}_2$ , P.E. Stallworth, U.S. Naval Academy, Dept. of Physics, Annapolis, MD 21402, USA; J.-B. d'Espinose, Laboratoire de Physique Quantique ESPCI, 10 rue Vauquelin, 75231 Paris Cedex 05, France; J. Manquet and F. Babonneau, Chimie de la Matière Condensée University, P. et M. Curie, 4 place Jussieu, 75252 Paris Cedex 05, France; J.-F. Guillemoles; Laboratoire d'Electrochimie et de Chimie Analytique ENSCP, 11 rue Pierre et Marie Curie, 75231 Paris Cedex 05, France

- N/PIII.26** INVESTIGATION OF CdTe SOLAR CELLS VIA CAPACITANCE AND IMPEDANCE MEASUREMENTS, G. Friesen, E. Dunlop, EC-DG JRC, ESTI, 21020 Ispra (VA), Italy
- N/PIII.27** DETERMINING THE SHEET RESISTANCE OF SUPERSTRATE CIS-SOLAR CELLS BY PLANAR ELECTRON BEAM INDUCED CURRENT MEASUREMENTS, J. Rechid\* and R. Reineke-Koch, ISFH, Sokelantstr. 5, 30165 Hanover, Germany, \*Present Address HMI, Kekule Str. 5, 12489 Berlin, Germany
- N/PIII.28** DIFFUSION LENGTH ESTIMATION BY THE PHOTOCURRENT-CAPACITANCE METHOD IN CuInSe<sub>2</sub> CELLS, C.H.Champness, Electrical and Computer Engineering Dept., McGill University, 3480 University Street, Montreal, Quebec, H3A 2A7, Canada
- N/PIII.29** POINT DEFECT TRANSPORT AND REACTIVITY IN CIGS: A NUMERICAL SIMULATION STUDY, G. Akodjenou<sup>(1)</sup>, S. Carniato<sup>(1)</sup>, G. Boureau<sup>(1)</sup>, E. Clolus<sup>(2)</sup>, J. Vedel<sup>(2)</sup> and J.F. Guillemoles<sup>(2)</sup>, <sup>(1)</sup>Laboratoire d'Electrochimie et de chimie Analytique, <sup>(2)</sup>Laboratoire de Chimie Physique, Matiere et Rayonnement, Universite Pierre et Marie Curie, 11 rue Pierre et Marie Curie, 75231 Paris Cedex 05, France

15:30                **BREAK**

## Session VII

**Chairperson : G. Hodes**

- N-VII.1** 16:00 **Invited** THE MORPHOLOGY, MICROSTRUCTURE AND MICROLUMINESCENT PROPERTIES OF CdS/CdTe, **M.M. Al-Jassim**, R.G. Dhere, K.M. Jones, H. Moutinho and Y. Yan, NREL, Golden CO 80401, USA
- N-VII.2** 16:30 **Invited** SURFACE SCIENCE CHARACTERISATION OF CIGS HETEROINTERFACES, **W. Jaegermann**, A. Klein, Darmstadt University of Technology, Materials Science Division, Petersenstr. 23, 64287 Darmstadt, Germany
- 17:00-18:30        **Discussion session 3**  
***Model, theory and characterisation, do they help cell optimisation ?***  
R.W. Birkmire, J.F. Guillemolles

**Friday June 2, 2000**  
Vendredi 2 juin 2000

**Morning**  
Matin

**Session VIII - Device modelling**

**Chairperson : J. Wienke**

- N-VIII.1** 9:00 **Invited** CHARACTERISATION AND MODELLING OF CHALCOPYRITE SOLAR CELLS,  
**R. Klenk**, Hahn Meitner Institute, Glienickerstr. 100, 14109 Berlin, Germany
- N-VIII.2** 9:30 **Invited** ELECTRONIC PROPERTIES OF Cu(In,Ga)Se<sub>2</sub> SOLAR CELLS-WHAT IS SPECIAL?  
**U. Rau**, Institut für Physikalische Elektronik, Pfaffenwaldring 47, 70569 Stuttgart,  
Germany
- N-VIII.3** 10:00 CLASSIFICATION OF ELECTRICAL METASTABILITIES Cu(In,Ga)Se<sub>2</sub> SOLAR  
CELLS, P. Zabierowski, M. Igalson, Faculty of Physics, Warsaw University of  
Technology, Koszykowa 75, 00-662 Warszawa, Poland and U. Rau, IPE, University of  
Stuttgart, Pfaffenwaldring 47, 70569 Stuttgart, Germany
- 10:20 **BREAK**
- 10:50-12:00 **Discussion session 4**  
*Small cells vs modules*  
J. Beier, J. Kessler

**END OF SYMPOSIUM N**