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4AV.1.19	Schottky Contacts on Cu(In,Ga)Se <sub>2</sub> Thin Films <i>E. Schlenker, V. Mertens, J. Parisi, R. Reineke-Koch, M. Köntges</i>	1793
4AV.1.22	High Efficiency CIS Modules for PV Concentrator Systems <i>H.-D. Mohring, U. Heckmann, J. Mattheis, U. Rau</i>	1796
4AV.1.25	Persistent Capture and Release of Electrons in CIGS Solar Cells <i>M. Igalson, M. Čwil, M. Edoff</i>	1800
4AV.1.27	A Study Into the Growth Kinetics and Properties of the Pseudo-Binary ZnO-SnO <sub>2</sub> for Use as a TCO in Thin Film Photovoltaics <i>D.A. Lamb, S.J.C. Irvine</i>	1804
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4AV.1.31	High-Efficient ZnO/PVD-CdS/Cu(In,Ga)Se <sub>2</sub> Thin Film Solar Cells: Preparation and New Insights in the Heterojunction Electronic Structure <i>M. Rusu, T. Glatzel, A. Neisser, C.A. Kaufmann, S. Sadewasser, M.C. Lux-Steiner</i>	1815
4AV.1.33	Growth and Characterization of CIGS Solar Cells by RF Magnetron Sputtering With Continuous Se Evaporation and End Point Detection <i>A.F. da Cunha, D. Rudmann, P.M.P. Salomé, F. Kurdesau</i>	1819
4AV.1.34	Local Optical and Optoelectronic Inhomogeneities in Cu(InGa)Se <sub>2</sub> -Absorbers from Spectrally Resolved Photoluminescence with Submicron Lateral Resolution <i>L. Gütay, G.H. Bauer</i>	1823
4AV.1.35	Raman Characterization of Cu(In,Ga)(S,Se) <sub>2</sub> for Thin Film Solar Devices <i>J. Palm, V. Probst, S. Jost, R. Hock, E. Rudigier, R. Scheer</i>	1827
4AV.1.36	Determination of Light Scattering Properties of Cu(In,Ga)Se <sub>2</sub> Films for Solar Cells <i>J. Krc, J. Malmström, F. Smole, M. Topič</i>	1831
4AV.1.37	Electronic Properties of CuInS <sub>2</sub> -on-Cu-Tape Solar Cells with and Without the CuI Buffer Layer <i>J. Verschraegen, M. Burgelman, J. Penndorf</i>	1835
4AV.1.38	A Kelvin Probe Force Microscopy Study of the PVD-CdS/Cu(In,Ga)Se <sub>2</sub> Interface Formation in Highly Efficient Thin Film Solar Cells <i>T. Glatzel, M. Rusu, S. Sadewasser, M.C. Lux-Steiner</i>	1839
4AV.1.40	CIGS PV Modules: Progress Regarding the Hybrid Process and TCO Deposition <i>A.E. Delahoy, L. Chen, B. Sang, S. Guo, J. Cambridge, R. Govindarajan, M. Akhtar</i>	1843
4AV.1.43	Study of the Effect of Different Plasma Density Areas on the Properties of ZnO Thin Films Deposited by DC Reactive Sputtering <i>A. Nemeth, A.L. Toth, E. Horvath, L. Kover, J. Toth, J. Volk, J. Mizsei, Z. Labadi</i>	1847
4AV.1.45	Analysis of Efficiency Limiting Processes in Thin Film Cu(In,Ga) (S,Se) <sub>2</sub> Electrodeposited Solar Cells <i>J.P. Connolly, Z. Djebbour, A. Darga, C. Bazin, D. Mencaraglia, M. Benosman, N. Bodereau, J.F. Guillemoles, D. Lincot, J. Kessler, N. Naghavi, J. Kurdi, O. Kerrec</i>	1851
4AV.1.47	Design Considerations and Implementation of Very-Large Scale Manufacturing of CIGS Solar Cells and Related Products <i>J.R. Tuttle, T. Schuyler, E. Choi, J. Freer</i>	1855

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4CV.1.3	Influence of the Thickness and the Oxygen Content on the Characteristics of ITO Thin Films Deposited at Room Temperature by In-Line Sputtering on Large Areas <i>C. Guillén, J. Herrero</i>	1859
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4CV.1.5	Electrical Properties of Zn <sub>2-2x</sub> Cu <sub>x</sub> In <sub>x</sub> Se <sub>2</sub> Thin Films Prepared by Selenization of Co-Sputtered Cu-In-Zn Alloys <i>V.A. Ivanov, V.F. Gremenok, I.A. Victorov, E.P. Zaretskaya, V.B. Zalesski, V.L. Kovalevski, O.V. Ermakov, K. Bente, W. Schmitz</i>	1863
4CV.1.6	Comparative Study of Indium Sulfide Thin Films Obtained by Chemical Bath and Modulated Flux Deposition Methods <i>B. Asenjo, C. Sanz, C. Guillén, A.M. Chaparro, J. Herrero, M.T. Gutiérrez</i>	1866
4CV.1.7	Effect of Indium Doping on the Properties of Chemical Bath Deposited Zn <sub>x</sub> Cd <sub>1-x</sub> S Window Layers <i>A. Antony, M.K. Jayaraj</i>	1870
4CV.1.10	Morphological and Optical Characterization of SnO <sub>2</sub> :F Thin Films Deposited By Spray Pyrolysis <i>M. Gracia, F. Rojas, G. Gordillo</i>	1874
4CV.1.12	Surface Treatments of CuGaSe <sub>2</sub> by Means of (In,Ga)-S <i>D. Fuertes Marrón, S. Lehmann, S. Doka, T. Schedel-Niedrig, M.C. Lux-Steiner</i>	1878
4CV.1.13	New Chemical Route for the Deposition of ZnS Buffer Layers: Cd-Free CuInS <sub>2</sub> -Based Thin Film Solar Cells with Efficiencies Above 11% <i>A. Ennaoui, M. Bär, J. Klaer, T. Kropp, R. Sáez-Araoz, M.C. Lux-Steiner</i>	1882
4CV.1.14	Energy and Life Cycle Assessment of Thin Film CdTe Photovoltaic Modules <i>M. Raugei, S. Bargigli, S. Ulgiati</i>	1886
4CV.1.15	Effect of Annealing on Structural and Optical Properties of Na-Incorporated CuInS <sub>2</sub> Thin Films <i>M. Zribi, M. Kanzari, B. Rezig</i>	1890
4CV.1.16	Zn <sub>2-2x</sub> Cu <sub>x</sub> In <sub>x</sub> Se <sub>2</sub> Thin Films for Solar Cell Applications: Structural and Photoluminescence Properties <i>E.P. Zaretskaya, A.V. Mudryi, V.F. Gremenok, V.B. Zalesski, O.V. Ermakov, K. Bente</i>	1894
4CV.1.19	Spray Deposited Nanocrystalline TiO <sub>2</sub> :CdTe, CdSe Thin Films for Photoelectrochemical Cell (PEC) Applications <i>V. Dutta, A. RangaRao</i>	1898
4CV.1.20	Quantitative SIMS Depth Profiling of CdTe/CdS/TCO Solar Cell Structures in the Back and Front Side Configurations <i>M. Emziane, K. Durose, D.P. Halliday, A. Bosio, N. Romeo</i>	1902
4CV.1.21	CuSbS <sub>2</sub> , a Possible Absorber for Extremely Thin Absorber Solar Cells <i>S.A. Manolache, M. Nanu, A. Duta, A. Enesca, A. Goossens, J. Schoonman</i>	1906
4CV.1.23	CIGS Solar Modules Contacted by Conducting Adhesives and Ultrasonic Welding <i>K. Herz, S. Schröder, M. Powalla, G.v.W. Wuytswinkel, G. Dreezen, G. Luyckx, H. Schäfer, T. Kowalik, K. Marnitz, R. Züst, B. Dimmler, F. Krautter</i>	1910
4CV.1.24	Stability Issues of Chalcopyrite Photovoltaic Devices <i>J. Klaer, R. Klenk, C. Köble, A. Boden, R. Scheer, H.-W. Schock</i>	1914
4CV.1.26	Empirical Tuning Methodology for As and Cl Doping of MOCVD Grown CdTe <i>V. Barrioz, R. Rowlands, S.J.C. Irvine</i>	1918
4CV.1.27	Thiourea Recovery and Water Saving from CdS-CBD Effluents in CIS Solar Cell Manufacturing <i>B. Malinowska, M. Rakib, G. Durand, B. Dimmler, M. Oertel, I. Luck, W. Eisele</i>	1922
4CV.1.33	Preparation of CuInS <sub>2</sub> Thin Films by Thermal Decomposition of Metal-Octoate and Subsequent Sulfurization Using DTBS <i>T. Hashimoto, S. Merdes, N. Takayama, H. Nakanishi, S.F. Chichibu, S. Ando</i>	1926
4CV.1.34	Long Term Stability in Cu(In,Ga)Se <sub>2</sub> Solar Cells with Different Buffer Materials <i>U. Malm, L. Stolt</i>	1930

## PV Modules and Components of PV Systems

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5DP.1.1	Evaluating the State of the Art of Photovoltaic Performance Modelling in Europe <i>S.R. Williams, T.R. Betts, R. Gottschalg, D.G. Infield, N.J.C.M van der Borg, A.R. Burgers, H.H.C. de Moor, W. Warta, G. Friesen, D. Chianese, A. Guérin de Montgareuil, T. Zdanowicz, D. Stellbogen, W. Herrmann, S.M. Pietruzko, J. Krustok, E.D. Dunlop</i>	1937
5DP.1.2	Long Term Reliability of PV Modules <i>J.H. Wohlgemuth, D.W. Cunningham, A.M. Nguyen, J. Miller</i>	1942
5DP.1.3	Loss Analysis of Solar Modules by Comparison of IV Measurements and Prediction from IV Curves of Individual Solar Cells <i>D.H. Neuhaus, R. Mehnert, G. Erfurt, M. Eberspächer, C. Hofbauer, M. Wolf, P. Magnucz, R. Lüdemann, A. Kubin</i>	1947
5DP.1.4	Concentration Photovoltaics for Highest Efficiencies and Cost Reduction <i>J. Luther, A. Luque, A.W. Bett, F. Dimroth, H. Lerchenmüller, G. Sala, C. Algora</i>	1953
5DP.1.5	Spanish Participation in the "Solar Decathlon 2005": Design and Simulation of the Photovoltaic System <i>M. Calvo-Fernández, J.E. Vega, M.A. Egido, E. Caamaño-Martín</i>	1958

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#### Balance of System Components

5CO.1.1	Lithium Batteries in Stand Alone Photovoltaic Applications <i>D. Mourzagh, S. Martinet, M. Perrin, F. Mattera, D. Fourmentel, Y Lausenaz, G. Sarre, J.C. Marcel</i>	1964
5CO.1.2	Integrated DC Switch Disconnecter for Photovoltaic Inverters <i>S. Buchhold, F. Greizer, J. Laschinski</i>	1968
5CO.1.3	A New Method for the Assessment of the Dynamic MPP Tracking Performance Based on Compressed High-Resolution Irradiation Patterns <i>R. Bründlinger, B. Bletterie, J. Brand</i>	1971
5CO.1.4	Development of an Universal Anti Thief System for PV Module <i>J.C. Marcel, G. Moine, M. Michou</i>	1975
5CO.1.5	Total Efficiency $\eta_{tot}$ - A New Quantity for Better Characterisation of Grid-Connected PV Inverters <i>H. Haeberlin, L. Borgna, M. Kaempfer, U. Zwahlen</i>	1977
5CO.1.6	Towards an Optimized Design Method for PV-Powered Consumer and Professional Applications – The SYN-Energy Project <i>E.A. Alsema, B. Elzen, N.H. Reich, W.G.J.H.M. van Sark, S.Y. Kan, S. Silvester, M. Veeffkind, J. Jelsma</i>	1981

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#### PV Module Technology

5CO.2.1	Increased Energy Collection Using Anti-Reflective Coated Glass <i>J.H. Wohlgemuth, D.W. Cunningham, A.M. Nguyen, J. Shaner, S.J. Ransome, A. Artigao, J.M. Fernández</i>	1985
5CO.2.2	Low-Stress Interconnections for Solar Cells <i>P.C. de Jong, D.W.K. Eikelboom, J.A. Wienke, M.W. Brieko, M.J.H. Kloos</i>	1989
5CO.2.3	Recent Progress with ApollonSolar's NICE Module Technology <i>R. Einhaus, K. Bamberg, R. de Franclieu, H. Lauvray, R. Monna</i>	1993
5CO.2.4	Laser Soldering - A Technology for Better Contacts? <i>H. Schmidhuber, S. Klappert, J. Stollhof, G. Erfurt, M. Eberspächer, R. Preu</i>	1997
5CO.2.5	Advantages of an UV-Resistant Polyurethane Frame <i>S. De Rycke</i>	2001

5CO.2.6	Vacuumfree Lamination of Solar Modules <i>G. Stollwerck, H.-G. Stevens, H.-J. Goerkes, W. Kaufhold, A. Lyding, H. Peerlings, E.-U. Reisner, J. Ufermann, M. Vogt</i>	2002
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### **ORAL PRESENTATIONS 5CO.3 PV Modules and Components of PV Systems**

#### **PV Modules in Systems**

5CO.3.1	A Novel Shading Analysis Method for PV Systems Using Sun Path Plots and High Resolution Performance Data <i>S. Firth, S.J. Rees, K. Lomas</i>	2005
5CO.3.2	Explosion Proof Certified Solar-Wind Hybrid Power Supply for Unmanned Offshore Production Platforms <i>J.R. de Vries, P. Strowlger, L. Young</i>	2009
5CO.3.3	Lightning and Surge Protection for Photovoltaic Installations - Laboratory Tests on Complete Systems <i>J. Birkl, B. Schulz</i>	2013
5CO.3.4	Description of 40kW Roof Mounted PV Thermal Concentrator System <i>J.F.H. Smeltink, A.W. Blakers, J.S. Coventry</i>	2015
5CO.3.5	How to Organise Electrical Insulation Safety in Grid Coupled PV Systems <i>P.J.L. Van Tichelen, D. Weyen</i>	2019
5CO.3.6	String Technology - A Successful Standard of the PV-System Technology for 10 Years Now <i>G. Cramer, B. Engel, F. Greizer, J. Laschinski, M. Meinhardt, M. Victor</i>	2023

### **ORAL PRESENTATIONS 5DO.7 PV Modules and Components of PV Systems**

#### **PV Concentrating Systems**

5DO.7.1	Analysis of the Radiation Flux Profile Along a PV Trough Concentrator <i>J.S. Coventry, A.W. Blakers, E. Franklin, G., Burgess</i>	2027
5DO.7.2	The PhoCUS Standard Unit: Design, Realization and Preliminary Performance Analysis <i>A. Sarno, F. Apicella, C. Cancro, R. Fucci, F. Pascarella, M. Pellegrino, C. Privato, F. Roca</i>	2031
5DO.7.3	Progress on 'CONMAN' EU R&D Project - Improvement of Photovoltaic Concentrating Systems and Technology Transfer to a Manufacturer <i>W. Browne, A. Wheldon, M. Norton, A. Iborra, J. Villarejo, E. Jódar, S.W. Glunz, A. Mohr, T. Roth, A.W. Bett, N. Gawehns, M. McCann, P. Fath, J. Jimenez, L. Alcedo, M. Bremerich, B. Clive, J. Andreu, C. Weatherby, R. Bentley, J. Brooker, S. Wheeler, J. Teruel</i>	2035
5DO.7.4	Energy Balance in a 2x Geometrical Concentration PV System <i>M. García, L. Marroyo, M. Arrarás, J.A. Donamaria, M.A. Pérez, F. Esparza</i>	2039
5DO.7.5	A 550X Concentrator System with Dome-Shaped Fresnel Lenses - Reliability and Cost <i>K. Araki, H. Uozumi, T. Egami, M. Hiramatsu, Y. Miyazaki, Y. Kemmoku, A. Akisawa, H.S. Lee, M. Yamaguchi</i>	2043
5DO.7.6	SunDog™ STCU: A Generic Sun Tracking Control Unit for Concentration Technologies <i>I. Luque-Heredia, J.M. Moreno, G. Quéméré, R. Cervantes, P.H. Magalhães</i>	2047

### **ORAL PRESENTATIONS 5DO.8 PV Modules and Components of PV Systems**

#### **Characterisation of PV Modules**

5DO.8.1	Outdoor Energy Rating of Photovoltaic Modules: Module Temperature Prediction and Spectral Mismatch Analysis <i>Y. Tang, G. Tamizhmani, L. Ji, C. Osterwald</i>	2051
5DO.8.3	Comparison Between Large Reference Cells Calibrated by ESTI-JRC, NREL and PTB, Performed at ECN <i>A. van der Heide, S. Winter, T. Moriarty, W. Zaaiman</i>	2055

5DO.8.4	Characterization of Recent Commercial Technologies of PV Modules Based on Outdoor and Indoor I-V Curve Measurements <i>F. Fabero, N. Vela, M. Alonso-Abella, F. Chenlo</i>	2059
5DO.8.5	Modeling of Array Performance Degradation Including Single-Module Failure <i>L. Abenante, F. De Lia, S. Castello</i>	2063
5DO.8.6	Comparison of System Performance Measuring Several Types of PV Modules <i>J. Tsutsui, K. Kurokawa</i>	2067
<b>VISUAL PRESENTATIONS 5BV.1 PV Modules and Components of PV Systems</b>		
5BV.1.1	Simulation of Heterogeneous PV Systems <i>R. Alonso, E. Román, S. Elorduizapatarietxe, P. Ibáñez, R. Moneo</i>	2071
5BV.1.2	Determination of Coefficients of Temperature Under Field Conditions by Software Multisol <i>J. Lämmel, S. Rensberg</i>	2074
5BV.1.3	Improved Performance PVT/AIR Solar Systems <i>J.K. Tonui, Y. Tripanagnostopoulos</i>	2077
5BV.1.5	Experimental Review and Analysis of Hot Spot Endurance Test Technique of PV Modules <i>Y. Murakami, Y. Uchida, S. Mizukami</i>	2081
5BV.1.6	A-Si Thin Film Modules: Operational Experience and Performance Dependency on PV Technology and Environment <i>F. Apicella, V. Giglio, M. Pellegrino, S. Ferlito, G. Flaminio, Y. Okamoto, F. Tanikawa</i>	2085
5BV.1.7	Module Efficiencies and Performance Measurements: Summary of a 10 Years Measuring Program <i>U. Rindelhardt, H. Fitterschneider, A. Gommlich</i>	2089
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