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## Volume II



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VB1.38	Static Micro-Concentrator Photovoltaic Module with an Acorn Shape Reflector <i>Uematsu T., Warabisako T., Yazawa Y., Muramatsu S., Ohtsuka H., Tsutsui K., Minemura J. &amp; Miyamura Y., Hitachi, Tokyo, Japan</i>	1570
VB1.39	Room Temperature Wet Chemical Growth of Passivating/Antireflection Coatings for Si-Based Solar Cells <i>Faur Ma. &amp; Faur Mi., SPECMAT, North Olmsted, USA; Bailey S.G., Flood D.J., Brinker D.J., NASA LeRC, Cleveland, USA; Faur H. M., SPECMAT, North Olmsted, USA; Alterovitz S.A. &amp; Wheeler D.R., NASA LeRC, Cleveland, USA; Boyd D. L., Kent State University, USA</i>	1574
VB1.40	Impurity Interactions in Solar Grade-Silicon, a Physico-Chemical Point of View <i>Duby J.-C. &amp; Durand F., CNRS and INP Grenoble, Saint Martin d'Herès, France</i>	1579
VB1.41	Photovoltaic Applications for High-Quality ITO Obtained by a Low Temperature e-Gun Deposition <i>De Rosa R., Grillo P., Roca F., Sinno G. &amp; Tucci M., CR ENEA, Portici, Italy</i>	1583
VB1.42	A Novel Type of MIS Inversion-Layer Silicon Solar Cell for Very High Efficiencies <i>Meyer R., Metz A., Grauvogl M. &amp; Hezel R., ISFH, Emmerthal, Germany</i>	1587
VB1.43	Improvement of SiO <sub>2</sub> Properties by High Pressure H <sub>2</sub> O Vapor Heating for Passivation of SiO <sub>2</sub> /Si Interfaces <i>Sakamoto K., Satoh M. &amp; Sameshima T., Tokyo Univ. of Agriculture and Technology, Japan</i>	1591
VB1.45	Dramatic Improvement of the Efficiency of Poor Quality Monocrystalline Silicon Solar Cells by HF Spraying <i>Saadoun M., Boujmil M.F., Bessaïs B. &amp; Ezzaouia H., Institut National de Recherche Scientifique et Technique, Hammam-Lif, Tunisia; Bennaceur R., Faculté des Sciences, Tunis, Tunisia</i>	1595

**VISUAL PRESENTATION VC5 Crystalline Silicon Solar Cells and Technologies,  
Poly Crystalline Silicon Solar Cells and Technologies**

**Chairperson:** D'Estaintot T., European Commission, DG XII, Bruxelles

VC5.2	Efficiency of Nanocavity Backside Gettering in Multicrystalline Silicon Wafers <i>Gay-Henquinet N. &amp; Martinuzzi S., University of Marseille, France</i>	1599
VC5.3	Optimization of Artistic Contact Patterns on Multicrystalline Silicon Solar Cells <i>Radike M. &amp; Summhammer J., Atominst. der Österreichischen Universitäten, Wien, Austria; Breymesser A. &amp; Schlosser V., Universität Wien, Austria</i>	1603
VC5.4	Surface Photovoltage Analysis of Phosphorus Gettering Process for Multicrystalline Cast Silicon Wafers <i>Inoue S., Ishikawa S. &amp; Saitoh T., Tokyo A &amp; T University, Japan; Hide I., Chitose Laboratory, Hokkaido, Japan</i>	1607
VC5.5	Towards a Stable Porous Silicon Layers for Silicon Solar Cells <i>Skryshevsky V.A., Shevchenko University, Kiev, Ukraine; Laugier A., INSA de Lyon, Villeurbanne, France; Litvinenko S. V. &amp; Strikha V.I., Shevchenko University, Kiev, Ukraine</i>	1611
VC5.8	Investigation of Polycrystalline Silicon Layers deposited by Hot Wire CVD <i>Breymesser A., Plunger V., Ramadori M. &amp; Schlosser V., Universität Wien, Austria; Nelhiebel M. &amp; Schattschneider P., Inst.für Angewandte &amp; Techn.Physik, Wien, Austria; Peiro D., Voz C., Bertomeu J. &amp; Andreu J., Universitat de Barcelona, Spain</i>	1615
VC5.9	RTLPCVD of in situ P-doped Polysilicon Emitter Solar Cells <i>Kallel S., Semmache B., Latreche S., Kaminski A., Lemiti M. &amp; Laugier A., INSA de Lyon, Villeurbanne, France</i>	1619
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VC5.13	Recent Progress with Acidic Texturing Solutions on Different Multicrystalline Silicon Materials Including Ribbons <i>Einhaus R., IMEC, Leuven, Belgium; Vazsonyi E., MTA-MFA, Budapest, Hungary; Duerinckx F. &amp; Horzel J., Van Kerschaver E., Szlufcik J., Nijs J. &amp; Mertens R., IMEC, Leuven, Belgium</i>	1630
VC5.14	Oxidized Porous Silicon Surface Layers on a n <sup>+</sup> Emitters <i>Strehlke S. &amp; Bastide S., CNRS-LPSB, Meudon, France; Stalmans L. &amp; Poortmans J., IMEC, Leuven, Belgium; Debarge L. &amp; Slaoui A., CNRS-PHASE, Strasbourg, France; Lévy-Clément C., CNRS-LPSB, Meudon, France</i>	1634
VC5.15	Hydrogen Passivation of Low- and High-Quality mc-Silicon for High-Efficiency Solar Cells <i>Lüdemann R., Hauser A. &amp; Schindler R., Fraunhofer ISE, Freiburg, Germany</i>	1638
VC5.16	Multicrystalline Silicon Solar Cells with Porous Silicon Selective Emitter <i>Bilyalov R.R., Lautenschlager H. &amp; Schindler R., Fraunhofer ISE, Freiburg, Germany</i>	1642
VC5.17	Pad Printing - A Novel Thick-Film Technique of Fine-Line Printing for Solar Cells <i>Hahne P., Reis I., Hirth E., Huljic D. &amp; Preu R., Fraunhofer ISE, Freiburg, Germany; de Buhr H., Schwichtenberg K. &amp; Ipsen H., Fachhochschule Stuttgart, Germany</i>	1646
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VC5.19	Screen Printing Contact and Good Light Confinement on Multicrystalline Silicon Solar Cells <i>El Omari H., Inst. Nat. des Sci. Appl. de Lyon, Villeurbanne, France; Sarti D., Photowatt International, Bourgoin-Jallieu, France; Boyeaux J. P., Kaminski A., Philippe A. &amp; Laugier A., Inst. Nat. des Sci. Appl. de Lyon, Villeurbanne, France</i>	1654
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VC5.21	Passivation of c-Si Solar Cells by Low Temperature H-Treatments and Deposited a-Si:H Layers <i>van Cleef M.W.M., Utrecht University, The Netherlands; Schuurmans F., ECN, Petten, The Netherlands; van der Heide A. S. H. &amp; Schönecker A., ECN, Petten, The Netherlands; Schropp R.E.I., Utrecht University, The Netherlands</i>	1661



VC5.22	Profiled Hot-Wire CVD Poly-Si:H Films for an n-i-p Cell on a Metal Substrate <i>Rath J.K., Feenstra K.F., van der Werf C.H.M., Hartman Z. &amp; Schropp R.E.I., Utrecht University, The Netherlands</i>	1665
VC5.23	First Solar Cells on Electrochemically Texturised Macroporous Silicon <i>Gamboa R., Martins M., Serra J.M., Maia Alves J. &amp; Vallera A.M., Universidade de Lisboa, Portugal; Ponomarev E.A. &amp; Lévy-Clément C., CNRS (UPR 1332), Meudon, France</i>	1669
VC5.24	LPE-Growth of Crystalline Silicon Layers on Ceramic Substrates <i>Schiermeier S.E.A., Tool C.J.J., van Roosmalen J.A.M., Laas L. J., von Keitz A. &amp; Sinke W.C., ECN Solar and Wind Energy, Petten, The Netherlands</i>	1673
VC5.25	Attacking Limiting Factors in 10x10 cm <sup>2</sup> Multicrystalline Silicon, Emitter Wrap-Through Solar Cells Design and Processing <i>Schönecker A., Weeber A. W. &amp; Sinke W. C., ECN Solar and Wind Energy, Petten, The Netherlands; Zechner C., Kress A. &amp; Fath P., University of Konstanz, Germany</i>	1677
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VC5.28	Investigation of Hydrogen Diffusion, Effusion and Passivation in Solar Cells Using Different Multicrystalline Silicon Base Materials <i>Spiegel M., Hahn G., Jooss W., Keller S., Fath P., Willeke G. &amp; Bucher E., University of Konstanz, Germany</i>	1685
VC5.29	Improvement of Diffusion Lengths in Multicrystalline Si by P-Al Co-Gettering During Solar Cell Processing <i>Jooss W., Hahn G., Fath P., Willeke G. &amp; Bucher E., University of Konstanz, Germany</i>	1689
VC5.30	Light Trapping in Silicon Solar Cells with a Mechanically Formed Blazed Surface Texture <i>Zechner C., Willeke G. &amp; Bucher E., University of Konstanz, Germany</i>	1693
VC5.31	Aspire Cells: From Modelling to Production of Irradiance References <i>Ruiz J.M., Alonso J. &amp; Martí A., UPM-Instituto de Energía Solar, Madrid, Spain; Schomann F., ASE, Heilbronn, Germany; Schmidt W., ASE, Alzenau, Germany; Zaaiman W., Helmke C., &amp; Agostinelli G., European Commission, DG JRC, Ispra</i>	1697
VC5.33	High Quality LPCVD Polycrystalline Silicon Films in Solar Cells Applications <i>Rogel R., Kis-sion K., Mohammed-Brahim T., Sarret M. &amp; Bonnaud O., UPRESA-CNRS 6076, Rennes, France; Kleider J. P., Universités de Paris VI et Paris XI, Gif-sur-Yvette, France</i>	1701
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VC5.35	Progress in Semitransparent Crystalline Silicon Solar Cells <i>Boueke A., Kühn R., Wibrat M., Fath P., Willeke G. &amp; Bucher E., Universität Konstanz, Germany</i>	1709
VC5.36	Which Structure for a Polycrystalline Silicon Thin Film Cell? <i>Cuniot M., Bardet E. &amp; Elkaim P., CNRS, Meudon, France</i>	1713
VC5.37	Porous Silicon Emitter Formation from Spin-On Glasses <i>Grigoros K., Semiconductor Physics Institute, Vilnius, Lithuania; Härkönen J., Helsinki University of Technology, hut, Finland; Jasutis V., Kindurys A., Pacebutas V., Sabaitaitė J. &amp; Imkienė I., Semiconductor Physics Institute, Vilnius, Lithuania</i>	1717
VC5.38	Optimum Process Scheme for the Production of (n) a-Si(p) c-Si Heterojunction Solar Cells <i>Borchert D. &amp; Grabosch G., University of Hagen, Germany</i>	1721
VC5.40	Polycrystalline Silicon Films for Solar Cells by Liquid Phase Epitaxy <i>Mishima T., Kitagawa Y., Ito S. &amp; Yokoyama T., Daido Hoxan, Osaka, Japan</i>	1724
VC5.41	Poly-Si Solar Cells with an Electrode along Grain Boundaries <i>Kim H.W., Lim D.G., Lee S. E., Kim S. &amp; Yi J., Sung Kyun Kwan University, Kyunggi-Do, Korea</i>	1728

**VISUAL PRESENTATION VD3 Crystalline Silicon Solar Cells and Technologies,  
Thin Film Silicon and Fabrication**

**Chairperson:** Barnett A., Astropower, Newark, USA

VD3.1	Effect of Buffer Layers on Optical Confinement in Thin Film Si Solar Cell Formed on Alumina Ceramic Substrate <i>Tazawa M., Yoshimura K., Igarashi K. &amp; Tanemura S., National Industrial Res. Inst. of Nagoya, Japan</i>	1728
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VD3.2	Polycrystalline Silicon Thin Films with Increased Grain Size Obtained by Low-Temperature Stepwise Annealing of Amorphous Silicon <i>Rüther R. &amp; Livingstone J., Univ. of Western Australia, Nedlands, Australia; Dytlewski N., Australian Nuclear Science and Technology Org., NSW, Australia</i>	1732
VD3.3	The Polycrystalline Silicon Thin Film Solar Cells Deposited on SiO <sub>2</sub> and Si <sub>3</sub> N <sub>4</sub> by RTCVD <i>Wang W., Zhao Y., Xu Y., Luo X., Yu M. &amp; Yu Y., Beijing Solar Energy Research Inst., P.R. China</i>	1736
VD3.4	Bifacial Solar Cells Fabricated by Combined Diffusion - Implantation Technology <i>Kreinin L., Bordin N. &amp; Eisenberg N., Jerusalem College of Technology, Israel; Grigorieva G., Zviagina K. &amp; Kagan M., Scientific Production Amalgamation "KVANT", Moscow, Russia</i>	1740
VD3.5	Application of Fine Electrode Formation and Surface Passivation for mc-Si Solar Cells <i>Komatsu Y., Okamoto S., Nunoi T. &amp; Sawai H., Sharp, Nara, Japan</i>	1744
VD3.7	Poly-Crystalline Silicon Thin Films Grown by DC Arc Discharge Ionplating and Their Characterization <i>Yoshida M., Saida T., Okada S. &amp; Akamatsu M., Kondo K., Stanley Electric, Ibaraki, Japan</i>	1748
VD3.8	Light Trapping and Amorphous / Crystalline Heterojunctions for Silicon Thin Film Solar Cells on Glass <i>Hausner R.M., Bergmann R.B. &amp; Werner J.H., Universität Stuttgart, Germany</i>	1751
VD3.9	Growth of Microcrystalline Silicon Film by Electron Beam Excited Plasma CVD without Hydrogen Dilution <i>Imaizumi M., Ito T., Okitsu K., Yamaguchi K., Yamaguchi M. &amp; Hara T., Toyota Technological Institute, Nagoya, Japan; Ban M. &amp; Tokai M., Kawasaki Heavy Industries, Chiba, Japan; Kawamura K., Chubu Electric Power, Nagoya, Japan</i>	1758
VD3.10	Film-Silicon Deposition Followed by Phosphorus Diffusion for Photovoltaic Application <i>van Zutphen A.J.M.M., Delft, University of Technology, The Netherlands; von Keitz A., ECN Solar and Wind Energy, Petten, The Netherlands; Zeman M. &amp; Metselaar J.W., Delft University of Technology, The Netherlands</i>	1762
VD3.11	Porous Silicon Reflector for Thin Silicon Solar Cells <i>Zettner J., ZAE Bayern, Erlangen, Germany; v. Campe H., ASE, Alzenau, Germany; Thoenissen M., Forschungszentrum Jülich, Germany; Auer R., ISFH, Emmerthal, Germany; Ackermann J., ASE, Alzenau, Germany; Hierrl T., Brendel R. &amp; Schulz M., ZAE Bayern, Erlangen, Germany</i>	1766
VD3.12	High Throughput Processing of Large Area Multicrystalline Silicon Solar Cells by Rapid Thermal Processing & Screenprinting <i>Sivovthaman S., Horzel J., Duerinckx F., De Schepper P., Laureys W., Szlufcik J., Nijs J. &amp; Mertens R., IMEC, Leuven, Belgium</i>	1770
VD3.13	Combination of RT-CVD and LPE for Thin Film Formation on Alumina Substrates <i>Bourdais S., Monna R., Angermeier D. &amp; Slaoui A., CNRS, Strasbourg, France; Rauf N., Laugier A., LPM, Villeurbanne, France; Mazel F., Jorand Y. &amp; Fantozzi G., INSA, Villeurbanne, France</i>	1774
VD3.14	Thin Polysilicon Films on Mullite Substrates for Photovoltaic Cell Application <i>Angermeier D., Monna R., Bourdais S., Slaoui A. &amp; Muller J.C., Laboratoire PHASE, Strasbourg, France; Beaucarne G. &amp; Poortmans J., IMEC, Heverlee, Belgium</i>	1778
VD3.15	Crystalline Silicon Thin-Film Solar Cells on SiC Based Ceramics <i>Reber S., Faller F., Hebling C. &amp; Lüdemann R., Fraunhofer ISE, Freiburg, Germany</i>	1782
VD3.16	Variations of the Back Surface Field in Silicon Thin -Film Solar Cells with Interdigitated Front Grid <i>Hebling C., Glunz S.W., Schumacher J.O. &amp; Knobloch J., Fraunhofer ISE, Freiburg, Germany</i>	1786
VD3.17	Silicon Sheets from Powder as Low Cost Substrates for Crystalline Silicon Thin Film Solar Cells <i>Zimmermann W., Bau S., Haas F., Schmidt K., &amp; Eyer A., Fraunhofer ISE, Freiburg, Germany</i>	1790
VD3.18	Thin Silicon Solar Cells Based on Recrystallized Layers on Insulating Substrates <i>Beaucarne G., IMEC, Leuven, Belgium; Hebling C., ISE, Freiburg, Germany; Scheer R., Hahn-Meitner-Institut Berlin, Germany; Poortmans J., IMEC, Leuven, Belgium</i>	1794
VD3.19	High Temperature Diffusion of Iron in PECVD-SiO <sub>2</sub> Barrier Layers for Crystalline Thin Film Silicon Solar Cells <i>Reber S., Aschaber J. &amp; Hurre A., Fraunhofer ISE, Freiburg, Germany</i>	1798
VD3.20	Low Temperature Growth of Crystalline Silicon Thin Films by ECR Plasma CVD for Solar Cells <i>Wang L., Gu M. &amp; Rehal H.S., South Bank University, London, United Kingdom</i>	1802
VD3.21	Growth of Doped Nanocrystalline $\beta$ -SiC for Use as a Crystalline Si Solar Cell Emitter <i>Toal S. &amp; Rehal H.S., South Bank University, London, United Kingdom</i>	1806

VD3.22	Fabrication of Integrated Silicon-on-Insulator Solar Cells <i>Takato H., Sekigawa T. &amp; Shimokawa R., Electrotechnical Laboratory, Ibaraki, Japan</i>	1810
VD3.23	Recrystallization-free Thin Film Crystalline Silicon Solar Cells on Foreign Substrates <i>Beaucarne G., Poortmans J. &amp; Caymax M. &amp; Nijs J., IMEC, Leuven, Belgium; Bourdais S., Angermeier D., Monna R. &amp; Slaoui R. A., CNRS-PHASE, Strasbourg, France</i>	1814
VD3.24	String Ribbon - A New Silicon Sheet Growth Method <i>Wallace R., Janoch R., Hanoka J.I., Evergreen Solar, Waltham, USA</i>	1818
VD3.25	High Productivity Methods of Preparation of EFG Ribbon Silicon Wafers <i>Kalejs J.P., ASE Americas, Billerica, USA; Schmidt W., ASE, Alzenau, Germany</i>	1822
VD3.26	Cost-Effective mc-Si Cell Processing by Screenprinting on Remote-PECVD Layers <i>Soppe W., Weeber A., de Moor H. &amp; Sinke W., ECN Solar and Wind Energy, Petten, The Netherlands; Lauinger T., Auer R., Lenkeit B. &amp; Aberle A.G., ISFH, Emmerthal, Germany</i>	1826
VD3.27	Improvement of Low Cost Ceramic Substrates for Use in Thin Film Silicon Solar Cells <i>von Keitz A., Roosmalen J.A.M., Tool C.J.J., Schiërmeier S.E.A., ECN Solar and Wind Energy, Petten, The Netherlands; van Zutphen A.J.M.M., Technical Universty Delft, The Netherlands; Fung F. &amp; Christie G.M., ECN Solar and Wind Energy, Petten, The Netherlands</i>	1829
VD3.28	Technology, Environmental Impact: A Preliminary Assessment of the Future Production Line of a New Crystalline Thin Film Silicon Solar Cell <i>Pschorr-Schoberer E., Reismayr D., Ludwig-Bölkow-Systemtechnik, Ottobrunn, Germany; Ostermayer A., Fachhochschule Bingen, Germany; Schindler J., Ludwig-Bölkow-Systemtechnik, Ottobrunn, Germany</i>	1833
VD3.29	Progress in Machine and Tool Development Towards The Implementation of The Mechanical Texturization in a cr Si Solar Cell Production Line <i>Gerhards C., Huster F., Spjègel M., Marckmann C., Fath P., Willeke G. &amp; Bucher E., University of Konstanz, Germany; Creager J. &amp; Narayanan S., Solarex, Frederick, USA</i>	1836
VD3.30	Mechanical Texturization and Hydrogen Passivation of RGS (Ribbon Growth on Substrate) Silicon Solar Cells <i>Hahn G., Zechner C., Spiegel M., Jooss W., Fath P., Willeke G. &amp; Bucher E., University of Konstanz, Germany</i>	1840
VD3.31	Adaptation of a FZ High Efficiency Bifacial Cell Process to Cz Material <i>del Cañizo C., Universidad Politécnica de Madrid, Spain; Moehlecke A. &amp; Zanescio I., Pontificia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil; Luque A., Universidad Politécnica de Madrid, Spain</i>	1844
VD3.32	Feedstock Evaluation for Czochralski Grown Silicon Solar Cells <i>Palm J. &amp; Endrös A.L., Siemens, Munich, Germany; Mihalik G., Matthäus A. &amp; Jester T., Siemens Solar Industries, Camarillo, Vancouver, USA</i>	1847
VD3.33	Novel Unipolar Thin Film Schottky Solar Cell <i>König D. &amp; Ebest G., Tech. Universität Chemnitz-Zwickau, Chemnitz, Germany</i>	1850
VD3.34	Screen Printing on Laser Doped Selective Emitters, for Large Area, Production Silicon Solar Cells <i>Grilli M.L., Arabito G., Artuso F., Barbarossa V., Belardinelli M., Besi-Vetrella U., ENEA Casaccia, Roma, Italy; Ferrazza F., Ginocchietti G. &amp; Nacci R., Eurosolare, Nettuno, Italy; Salza E., Pirozzi L., ENEA Casaccia, Roma, Italy</i>	1854
VD3.35	Results and Analysis of Multicrystalline-Electromagnetic Cold Crucible Continuous Casting Silicon Solar Cells <i>El Moussaoui A., Tobías Y. &amp; Luque A., ETSI Telecommunication-UPM, Madrid, Spain</i>	1858
VD3.36	Properties of Solid Phase Crystallized poly-Si Thin Film from PECVD a-Si:H Deposited on Quartz Substrate <i>Addonizio M.L., Delli Veneri P., Fameli G., Loreti S., Minarini C., Privato C., Sinno G., Terzini E. &amp; Vancini M., ENEA, Portici, Italy</i>	1862
VD3.37	Hydrogenated Porous Silicon in Solar Cell Structures <i>Yerokhov V.Y., Melnyk I.I. &amp; Bogdanovsky Y.N., Iznin O.I., State University 'Lviv Polytechnic', Ukraine</i>	1866
VD3.38	Growth of 240 kg Multicrystalline HEM <sup>TM</sup> Silicon Ingots <i>Khattak C.P. &amp; Schmid F., Crystal Systems, Salem, USA</i>	1870
VD3.39	Comparison of Different Simple Fabrication Processes for High Efficiency Silicon Solar Cells <i>Tamasi M.J.L., Plá J.C., Bolzi C.G., Martínez Bogado M.G., Venier G.L. &amp; Durán J.C., CAC-CNEA, Villa Maipú, Argentina</i>	1874

VD3.40	Designing the New Electromagnetic Puller for Multicrystalline Silicon: Application of Specific Models <i>Ribeyron P.-J., Durand F., Gagnoud A., EPM - Madylam, Saint Martin d'Hères, France</i>	1878
VD3.41	Solid Phase Crystallisation of Amorphous Silicon: in-situ Electrical Characterisation of the Nucleation Process Control by Dopants <i>Mencaraglia D., Kim K. S., URA 127 CNRS, Gif-sur-Yvette, France; Bardet E., Cuniot M., Dixmier J. &amp; Elkaim P., LPSB, Meudon, France; Caristan E., URA 127 CNRS, Gif-sur-Yvette, France</i>	1882
VD3.42	Multicrystalline Baysix® Silicon for High-Efficient Solar Cells from the New-Freiberg Production Facility <i>Häßler C., Koch W., Krumbe W. &amp; Thurm S., Bayer, Krefeld, Germany; Müller A. &amp; Schwirtlich I.A., Bayer Solar, Freiberg, Germany</i>	1886
VD3.43	Innovative Process for the Cost-Effective Production of Highly Efficient Silicon Solar Cells <i>Metz A. &amp; Hezel R., ISFH, Emmerthal, Germany</i>	1890
VD3.45	Comparison of Front and Back Surface Passivation Schemes for Silicon Solar Cells <i>Moschner J., ISFH, Emmerthal, Germany; Doshi P., Georgia Institute of Technology, Atlanta, USA; Ruby D.S., Sandia National Laboratories, Albuquerque, USA; Lauinger T., Angewandte Solarenergie, Alzenau, Germany; Aberle A.G., ISFH, Emmerthal, Germany; Rohatgi A., Georgia Institute of Technology, Atlanta, USA</i>	1894

**PV Modules and Components of PV Systems** 1899

**PLENARY SESSION PB4 PV Modules and System Components, Quality of Modules and Components**

**Chairpersons:** Benemann J., Pilkington Solar, Köln, Germany

Sakuta K., Electrotechnical Laboratory, Ibaraki, Japan

PB4.1	Rehabilitating Amorphous Silicon - Recent Advances in a-si Module Production Technology <i>Wolfe P.R., Intersolar Group, Bucks, United Kingdom; Jansen S.W., Waterton Industrial Estate, Bridgend, United Kingdom</i>	1091
PB4.2	New Protection Principle against Hot Spots in Crystalline Silicon Cell Modules for Implementing in Module-Integrated Inverters <i>Schmid R. &amp; Real M.G., Alpha Real, Zürich, Switzerland; de Broe A. &amp; Jantsch M., ECN, Petten, The Netherlands; Bishop J., European Commission, DG JRC, Ispra; Moschella U., ANIT, Genova, Italy; Hommerson R., Mastervolt, Amsterdam, The Netherlands</i>	1906
PB4.3	FlexConnect a Milestone on the Pathway to an Automated Production of Modules Using Cells and Polymers Only <i>Schüren J., Sun Ware, Duisburg, Germany</i>	1912
PB4.4	Laminated Film Material for Solar Cell Encapsulation and Their Influence on PV-Module Production and Development <i>Plessing A.K., Degiampietro S. &amp; Pèrl P., Isovolta, Werndorf, Austria</i>	1915
PB4.5	Qualification Testing of AC Modules <i>Bishop J., Sachau J. &amp; Zaيمان W., European Commission, DG JRC, Ispra</i>	1920
PB4.6	A Survey on the Electrical Insulation Behaviour of the PV Module Encapsulant Materials <i>Pellegrino M., Parretta A. &amp; Sarno A., ENEA, Portici, Italy</i>	1926

**PLENARY SESSION PC3 PV Modules and System Components, Balance-of-System Components**

**Chairpersons:** Kitamura A., Research Association, Tokyo, Japan

Sardi L., Ansaldo, Genova, Italy

PC3.1	Progress in Photovoltaic System and Components Improvements <i>Thomas H.P., Kroposki B., McNutt P. &amp; Witt E., NREL, Golden, USA; Bower W., Bonn R. &amp; Hund T.D., Sandia National Laboratories, Albuquerque, USA</i>	1930
PC3.2	New Methods to Characterise PV Batteries <i>Mattera F., Malbranche Ph., Desmettre D. &amp; Martin J.-L., GENEC, St. Paul lez Durance, France</i>	1936
PC3.3	Sophisticated Verification of Simple Monitored Data for Japanese Field Test Program <i>Kurokawa K., Sugiyama H. &amp; Uchida D., Tokyo University, Japan; Sakamoto K. &amp; Ohshiro T., JQA Organization, Shizuoka, Japan; Otani K., MITI, Electrotechnical Laboratory, Ibaraki, Japan; Fukasawa K., NEDO, Tokyo, Japan</i>	1941

- PC3.4 Field Experience with a New Performance Characterization Procedure for Photovoltaic Arrays  
*King D.L., Kratochvil J.A., Boyson W.E. & Bower W., Sandia National Laboratories, Albuquerque, USA* 1947
- PC3.5 A Possibility for Recycling PV Module from a Life-Cycle View Point  
*Kato K., Murata A. & Sakuta K., MITI, Energy Technology Division, Ibaraki, Japan; Yamada K., University of Tokyo, Japan* 1953
- PC3.6 Battery Inverter for Modularly-Structured PV Power Supply Systems  
*Burger B. & Cramer G., SMA Regelsysteme, Niestetal, Germany; Engler A., Kansteiner B. & Zacharias P., ISET, Kassel, Germany* 1959

**PLENARY SESSION PDI PV Modules and System Components**

**Chairpersons:** Greif J., European Commission, DG XII, Brussels

Wohlgemuth J., Solarex, Frederick, USA

- PD1.1 480 kWpeak EUCLIDES™ Concentrator Power Plant Using the Parabolic Troughs  
*Sala G., Arboiro J. C., Luque A. & Antón I., Universidad Politécnica de Madrid, Spain; Gasson M.P., Mason N.B., Heasman K.C. & Bruton T.M., BP Solar, Sunbury-on-Thames, United Kingdom; Mera E., Cambior E. & Datta E., BP Solar España, Alcobendas, Spain; Cendagorta M., Friend M.P., Valera P., González S., Dobón F. & Pérez F., ITER, Santa Cruz de Tenerife, Spain* 1963
- PD1.2 Manufacturing Improvements in the Photovoltaic Manufacturing Technology (PVMAT) Project  
*Witt C.E., Mitchell R.L., Thomas H. & Symco M. I., NREL, Golden, USA; King R., U.S. Department of Energy, Washington, USA; Ruby D.S., Sandia National Laboratories, Albuquerque, USA* 1969
- PD1.3 A New Encapsulant Material for Photovoltaic Modules  
*Hanoka J.I., Evergreen Solar, Waltham, USA* 1974
- RD1.4 Design and Operational Experience with Small and Medium Sized Inverters in the Netherlands  
*Marsman H., Kil A.J., Hoekstra K.J. & Burges K., Ecofys Energy and Environment, Utrecht, The Netherlands; Hommerson J.R., Mastervolt, Amsterdam, The Netherlands; Oldenkamp H., NKF KABEL, Delft, The Netherlands* 1978
- PD1.5 Double-Layer-Capacitors for PV-Applications  
*Landau M., Knorr R., Willer B., Wollny M. & Zacharias P., ISET, Kassel, Germany* 1984
- PD1.6 PV Module Integrated with Metal Curtain Wall  
*Yoshida S., Yoshino M., Takahashi M. & Mori T., YKK Corporation, Toyama, Japan; Shirasawa K., Plant Kyocera, Shiga, Japan* 1987

**VISUAL PRESENTATION VA4 PV Modules and System Components**

**Chairperson:** Sarti D., Photowatt, Bourgoin-Jallieu, France

- VA4.1 Increased Energy Yield of 50% at Flat Roof and Field Installations with Optimized Module Structures  
*Quaschnig V. & Hanitsch R., Berlin University of Technology, Germany* 1993
- VA4.3 Energetic and Economic Design and Simulation of Autonomous Photovoltaic Plants via Internet  
*Brugmann J., Dreß A., Kohlmann F. & Markert G., Universität GH Essen, Germany* 1997
- VA4.4 Improved Accuracy for Low-Cost Solar Irradiance Sensors  
*King D.L., William E., Boyson W.E., Barry R., Hansen B.R. & Bower W., Sandia National Laboratories, Albuquerque, USA* 2001
- VA4.5 Variable Illumination Measurements (VIM) of Amorphous Silicon Solar Modules after Ten Years Operation  
*Merten J., Muñoz A., Voz C., Asensi J.M. & Andreu J., Universitat de Barcelona, Spain; Camani M., Cereghetti N., Chianese D. & Rezzonico S., TISO, Cannobio, Switzerland* 2005
- VA4.6 Power Rating and the Need of Photovoltaic Modules Measurements in Brazilian Dissemination Program  
*Zilles R., IEE/USP, São Paulo, Brazil; Ribeiro C., CEPTEL, Rio de Janeiro, Brazil; Moszkowicz M., Conselho Nacional de Desenvolvimento Científico e Tecnológico, Brazil* 2009
- VA4.8 Photovoltaic Control Unit for Grid Connected PV Systems Tested Within The Green Pricing Project UMWLTPLUS of RWE Energie AG  
*Heilscher G., IST Energietechnik, Augsburg, Germany; Hoppe W., RWE Energie, Andernach, Germany* 2013

VA4.9	Results of an Inverter-Field-Test on 100 Gridconnected PV-Systems <i>Heilscher G., Schneider M. &amp; Pfatischer R., IST Energietechnik, Augsburg, Germany</i>	2017
A4.10	Islanding of Grid-Connected PV Inverters: Test Circuits and some Test Results <i>Haeblerlin H. &amp; Graf J., Berner Fachhochschule, Burgdorf, Switzerland</i>	2020
VA4.11	Grid Friendly PV-IGBT-Power Conditions Units from 20 KVA up to 1.2 MVA <i>Kremer P. &amp; Diwes A., Siemens, Erlangen, Germany</i>	2024
VA4.12	Measurement and Analysis Program in Japanese Monitoring Program of Residential PV Systems <i>Yamada T., Nakamura H. &amp; Ohshiro T., Japan Quality Assurance Organization, Shizuoka-ken, Japan; Sakuta K., Electrotechnical Laboratory, Ibaragi, Japan; Kurokawa K., Tokyo University of Agriculture and Technology, Japan</i>	2028
VA4.13	Meteorological Analysis for Suitable Design of Photovoltaic Power Generation Systems: Preparation of Meteorological Data (METPV) which is Useful to Simulate Output from PV Systems <i>Itagaki A., Iida H. &amp; Okamura H., Japan Weather Association, Tokyo, Japan</i>	2032
VA4.14	Sensitivity of Photovoltaic Facade Modules to Overheating Conditions <i>Gajewski S., Bücher K., Laukamp H. &amp; Zastrow A., Fraunhofer ISE, Freiburg, Germany</i>	2036
VA4.15	A Systematic Approach to Supervision and Fault Diagnosis of Grid-Connected Photovoltaic Systems <i>Kaiser R., "Free Lance", Fraunhofer ISE, Freiburg, Germany; Schacht V., Laukamp H., Seitz S. &amp; Schweizer-Ries P., Fraunhofer ISE, Freiburg, Germany</i>	2040
VA4.17	Voltage Source Inverters for Grid Connected Photovoltaic Systems <i>Hinz H. &amp; Mutschler P., Darmstadt University of Technology, Germany</i>	2045
VA4.18	Maximum Power Point Tracking Using a Neural Network Model for Grid-Connected PV Systems <i>Al-Amoudi A. &amp; Zhang L., University of Bradford, United Kingdom</i>	2049
VA4.19	Application-Related Features of a-Si Based PV Technology <i>Schade H., Lechner P., Geyer R., Frammelsberger W., Rübél H., Schmid M. &amp; Maurus H., Phototronics Solartechnik, Putzbrunn, Germany; Hoffmann W., ASE, Alzenau, Germany</i>	2054
VA4.20	How Long Will My PV Plant Last? <i>Camani M., Cereghetti N., Chianese D. &amp; Rezzonico S., TISO, Canobbio, Switzerland</i>	2058
VA4.21	PV Cladding Thermal Gains: Experimental Results from Three PV Cladding Systems Investigating the Effects of Design on the Operational Temperatures <i>Crick F.J. &amp; Wilshaw A., IT Power, Hants, United Kingdom; Pearsall N. &amp; Hynes K., University of Northumbria, Newcastle-upon-Tyne, United Kingdom; Shaw M., Ove Arup and Partners, Newcastle-upon-Tyne, United Kingdom; Young G., Ove Arup &amp; Partners, London, United Kingdom; Baker P., BRE, Glasgow, United Kingdom</i>	2062
VA4.22	A Long Term Cycle Test of Storage Batteries Newly Developed for Advanced PV Application <i>Tagigawa K. &amp; Kobayashi H., CRIEPI, Tokyo, Japan</i>	2066
VA4.23	Innovative Load Management for Multi-User PV Stand-Alone Systems <i>Vallvé X., Merten J. &amp; Figuerol E., Trama Tecnoambiental, Barcelona, Spain</i>	2070
VA4.24	Design of a New Photovoltaic Pump Inverter <i>Klemt M. &amp; Dauer O., ATPE, Eching, Germany; Mayer O., Sigfusson G. &amp; Zängerl H.-P., Universität der Bundeswehr München, Germany</i>	2074
VA4.27	Next Generation of AC-Module Inverters <i>Oldenkamp H. &amp; de Jong I., OKE-Services, The Netherlands</i>	2078
VA4.29	Testing Inverters for Utility Interactive Operation <i>Wilk H., Oberösterreichische Kraftwerke, Linz, Austria; Schauer G., Verbundgesellschaft, Wien, Austria; Harich &amp; Enders, Österr. Forschungszentrum Arsenal, Wien, Austria</i>	2082
VA4.31	Cost Reduction by Integration of Converter and Charge Controller <i>Adelmann P. &amp; Gutzeit D., Steca, Memmingen, Germany; Rimpler G. &amp; Panhuber C., Fronius KG, Wels, Austria</i>	2086
VA4.32	Simulation Results of Stand-Alone PV-Systems under Various Load Conditions <i>Tsuda I., Nozaki K. &amp; Sakuta K., Electrotechnical Laboratory, Ibaraki, Japan; Oshiro M., Solar Techno-Center, Shizuoka, Japan; Kurokawa K., University of Tokyo Agriculture and Technology, Japan</i>	2088

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**Chairperson:** Witt C.E., NREL, Golden, USA

- VA5.6 Basic Research on the Estimation of Instantaneous Power of Photovoltaic System by Using Camera Images  
*Katagi T., Yamamoto S., Hirayama S., Yamanouchi Y. & Park J. S., Kobe University of Mercantile Marine, Japan; Hashimoto T., Shizuoka University, Japan* 2092
- VA5.8 43 kW PV at Facades and Roofs of a Public Building - Peculiarities in Design and Operation, Thermohydraulic Description of the Modules  
*Groehn H.-G. & Barthels H., Forschungszentrum Jülich, Germany* 2096
- VA5.9 Modelling a Hybrid PV/T Collector  
*Mattei M., Cristofari C. & Louche A., Université de Corse, Ajaccio, France* 2100
- VA5.10 A New Type of Module Integrated Converter with Wide Voltage Matching Ability  
*Kusakawa M., Tokyo University of Agriculture and Technology, Japan; Nagayoshi H., Shonan Institute of Technology, Kanagawa, Japan; Kamisako K. & Kurokawa K., Tokyo University of Agriculture and Technology, Japan* 2104
- VA5.11 Assessment of Blocking and Bypass Diodes Application in PV Power Plants  
*Iliceto A. & De Angelis G., ENEL SRI-PAL, Cologno Monzese (MI), Italy; Guastella S. & Patané R., CONPHOEBUS, Piano d'Arce (CT), Italy* 2108
- VA5.12 Differential MPP Controlling  
*Cendagorta M., Galbas R., Monzón M. R., Dobón F., Pérez F., Garcia B., López-Manzanares O., Friend M.P., Valera P., González S., Baussou D., Lugo A., Sánchez A., ITER, Tenerife, Spain* 2112
- VA5.13 Design and Development of Teide Inverter  
*Cendagorta M., Friend M.P., Pérez F. & Valera P., ITER, Tenerife, Spain; González S. & Sánchez V., SGM-F/IMASDE, Tacoronte, Spain; Dobón F., EDG, La Laguna, Spain; Galbas R., Kassel University, Germany* 2115
- VA5.16 MSD - Mains Monitoring Devices with Allocated Switching Devices - A New Safety Standard for Grid Connected PV-Systems  
*Köln K., UFE, Wanzer, Germany* 2119
- VA5.17 Single Cell Module Integrated Converter System (SCMIC) Final Results  
*Meyer T. & Schmidt H., Fraunhofer ISE, Freiburg, Germany; Toggweiler P., Enecolo, Mönchaltorf, Switzerland; Riatsch J. & Schmidt R., ETH, Zürich, Switzerland; Weng M. & Guillaudeau D., NAPS France, Lens, France* 2121
- VA5.18 Energy Pay-Back Time of Photovoltaic Energy Systems: Present Status and Prospects  
*Alsema E.A., Utrecht University, The Netherlands; Frankl P., INSEAD, Fontainebleau, France; Kato K., AIST, Ibaraki, Japan* 2125
- VA5.19 Development of a Fault Detection System in a PV Installation  
*Hernández J.C. & Almonacid G., Universidad de Jaen, Spain* 2131
- VA5.21 Experimental Study of Stratification of Electrolyte in Lead/Acid Batteries Used For solar Energy  
*Desmettre D. & Mattera F., GENEC, St. Paul lez Durance, France; Alzieu J., EDF, Moret-sur-Loing, France* 2135
- VA5.22 Battery Charge Behavior in Stand-Alone Systems with Concentrator Modules  
*Copetti J.B., UNISINOS, São Leopoldo, Brazil; Zanesco I., Pontificia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil* 2139
- VA5.23 PV Array and Battery Modeling with PSpice  
*Yu G.-J., Song J. & Kang G., KIER, Taejon, Korea; No M. & Sung S., ChungNam National University, Korea* 2142
- VA5.24 HICAAP - Highly Integrateable Converters for Advanced AC-Photovoltaics Study of Topologies, Principle Design  
*Myrzik J., Universität GH-Kassel, Germany; Meinhardt M., NMRC, Cork, Ireland; de Mey B., IMEC, Leuven, Belgium; Flannery J., NMRC, Cork, Ireland; Frumau C. F. A., ECN, Petten, The Netherlands; Hofkens H., SOLTECH, Leuven, Belgium; Jantsch M., ECN, Petten, The Netherlands; Krieger Th., ISET, Kassel, Germany; Schneider H., NMRC, Cork, Ireland; Vanwijnsberghe G., IMEC, Leuven, Belgium; Zacharias P., ISET, Kassel, Germany* 2146

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#### **VISUAL PRESENTATION VB6      PV Modules and System Components**

**Chairperson:** Sachau J., European Commission, DG JRC, Ispra

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#### **VISUAL PRESENTATION VC4      PV Modules and System Components**

**Chairperson:** Chehab O., Pilkington Solar, Köln, Germany

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