

**CSSC-11 and SiMat-4 Joint Workshop  
program**

**Wednesday, April 20**

11h00m	Registration
11h40m	Opening
12h00m	<b>Detection of H in p-type silicon materials using FR-IR spectroscopy</b> Erik Marstein IFE, Norway
12h40m	<b>Growth of silicon single crystals with a diameter of 4 inch using the granulate crucible method</b> R. Menzel, K. Dadzis, A. Nikiforova, N. Lorenz-Meyer, B. Faraji-Tajrishi, N. Abrosimov, H. Riemann Leibniz-Institut für Kristallzüchtung
13h00m- 14h00m	<b>Lunch</b>
14h00m	<b>Novel monocrystalline materials OXYGEN, CARBON AND OTHER INTERESTING COMPONENTS OF THE FIRST SINGLE CRYSTAL SILICON RIBBONS PULLED HORIZONTALLY FROM A MELT</b> Nathan Stoddard, Jesse Appel, Alireza Pirnia, Cecilia Lee, Peter Kellerman and Parthiv Daggolu Leading Edge Equipment Technologies
14h40m	<b>Twin formation in high-velocity Czochralski growth of photovoltaic silicon</b> Xiang Lu, Shuai Yuan*, Xuegong Yu, Deren Yang Zhejiang University, Hangzhou, China
15h00m	<b>Dislocation activation conditions and dynamics studied in situ by X-ray diffraction imaging in monocrystalline Si near the melting point</b> Serge Neves Dias, Maike Becker, Hadjer Ouaddah, Isabelle Périchaud, Guillaume Reinhart, Nathalie Mangelinck-Noël, Gabrielle Regula* Aix Marseille Univ, Université de Toulon, Marseille, France
15h20m	<b>Material evaluation for engineering a novel crucible setup for the growth of oxygen free Czochralski silicon crystals</b> F. Sturm 1*, M. Trempa 1, G. Schuster 2, R. Hegermann 2, P. Götz 2, R. Wagner 3, G. Barroso 3, P. Meisner 4, C. Reimann 1, J. Friedrich 1 1 Fraunhofer IISB, Schottkystrasse 10, 91058 Erlangen, Germany 2 CVT GmbH & Co. KG, Romantische Strasse 18, 87642 Halblech, Germany 3 Rauschert Heinersdorf-Pressig GmbH, Bahnhofstrasse 1, 96332 Pressig, Germany 4 SGL Carbon GmbH, Drachenburgstrasse, 53170 Bonn, Germany
15h40m- 16h00m	<b>Coffee break</b>

- Defects in silicon**  
**Kinetics of Light-Induced Instability in Bifacial N-Type Silicon Heterojunctions**  
 16h00m  
 Brendan Wright  
 UNSW (Aus)
- Characterisation of Striations in n-type Silicon Wafer Processed with Polysilicon Contacts**  
 16h20m  
 Zhuangyi Zhou 1\*, Fiacre Rougieux 1, Manjula Siriwardhana 2, Daniel MacDonald 2, Gianluca Coletti 1,3  
 1 School of Photovoltaic and Renewable Energy Engineering, The University of New South Wales, Australia  
 2 College of Engineering and Computer Science, Australian National University, Australia  
 3 TNO Energy Transition, Westerduinweg 3, 1755 LE Petten, the Netherlands
- A Study on Degradation Mechanisms in the Czochralski Grown Si Crystal for Solar Cell Applications**  
 16h40m  
 Rasit Turan 1,2, Sercan Aslan 1,2, Mehmet Konyar 4, Nurhayat Yıldırım 4, Bulent Arıkan 1, Gence Bektaş 1,3, Hasan Hüseyin Canar 1,3, Salar Habibpur Sedani 1,3, Fırat Es 4,  
 1 Middle East Technical University- Center for Solar Energy Research and Applications (ODTÜ-GÜNAM), Ankara, Turkey  
 2 Department of Physics, Middle East Technical University (METU), Ankara, Turkey  
 3Micro and Nanotechnology Program (MNT), Middle East Technical University (METU), Ankara, Turkey  
 4 Kalyon PV Research and Development Center, Kalyon Güneş Teknolojileri Üretim A.Ş., 06909, Ankara, Turkey
- Copper in compensated p-type and n-type Czochralski silicon: diffusivity, influence on the majority carrier density and mobility**  
 17h00m  
 Guilherme Gaspar 1, Chiara Modanese 1, Sarah Bernardis 2, Nicolas Enjalbert 2, Lars Arnberg 1, Sebastien Dubois 2, Marisa Di Sabatino 1\*  
 1 Norwegian University of Science and Technology (NTNU), Department of Materials Science and Engineering, Trondheim, Norway  
 2 Univ. Grenoble Alpes, (CEA), LITEN, Department for Solar Energy, National Institute of Solar Energy, France

**Thursday, April 21**

- Directional solidification, UMG and characterisation**  
**Decomposition of small-angle grain boundaries during directional solidification of multicrystalline silicon**  
 8h30m  
 Lu-Chung Chuang\*, Kensaku Maeda, Haruhiko Morito, Kozo Fujiwara  
 Tohoku University, Japan
- Towards Low-cost High-efficiency and Reliable Upgraded Metallurgical Silicon Solar Cells**  
 9h00m  
 C. del Cañizo 1\*, N. Dasilva-Villanueva 1, D. Fuertes Marrón 1, B. Arıkan 2, H. H. Canar 2, R. Turan 2,3, G.Sánchez Plaza 4, L. Méndez 5, E. Forniés 5  
 1 Instituto de Energía Solar – Universidad Politécnica de Madrid, Avda. Complutense, 30, Madrid, Spain

2 Center for Solar Energy Research and Applications (GÜNAM), Ankara, Turkey

3 Department of Physics, Middle East Technical University, Ankara, Turkey

4 Nanotechnology Center – Universidad Politécnica de Valencia, Camino de Vera, Valencia, Spain

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5 Aurinka PV Group, Marie Curie 19, Rivas-Vaciamadrid (Madrid), Spain

- 9h20m **Adjustment of resistivity for phosphorus doped n-type multicrystalline silicon**  
Iryna Buchovska\*, Kaspars Dadzis, Natasha Dropka, Frank M. Kiessling  
Leibniz-Institut für Kristallzüchtung (IKZ)
- 9h40m **Growth rate-temperature gradient diagrams for control of grain structure in PV ingots**  
Thierry Duffar 1,2\*  
1 Univ. Grenoble Alpes, CNRS, Grenoble INP\*, SIMAP, F-38000 Grenoble, France  
\* Institute of Engineering Univ. Grenoble Alpes  
2 Visiting Professor, Institute for Materials Research, Tohoku University, Sendai, Japan
- 10h00m **Microscopic Charge Carrier Lifetime Mapping for Silicon Material Analysis**  
Friedemann D. Heinz 1,2\*, Maximilian Özkent 2, Clara Rittmann 2, Florian Schindler 2, Martin C. Schubert 2, Wolfram Kwapil 1,2, Stefan Glunz 1,2  
1 Laboratory for Photovoltaic Energy Conversion, Department for Sustainable Systems Engineering (INATECH), University Freiburg, Germany  
2 Fraunhofer Institute for Solar Energy Systems (ISE), Freiburg, Germany
- 10h20m-11h40m **Coffee break + Poster session**
- 11h40-13h00m Discussion hot topics
- 14h00m **Afternoon tour and dinner**

## Friday, April 22

- 8h20m **Impact of material properties on cell performance I**  
Auger parametrization for silicon PV  
Tim Niewelt  
Fraunhofer ISE  
Warwick University, UK
- 9h00m **PERC-cells from 100% recycling-silicon from end-of-life PV-modules**  
P. Dold 1, A. Obst 1, P. Henatsch 1, F. Zobel 1, S. Riepe 2, D. Wagenmann 2, E. Lohmüller 2, S. Lohmüller 2  
1 Fraunhofer Center for Silicon Photovoltaics CSP, Halle (Saale), Germany  
2 Fraunhofer Institute for Solar Energy Systems ISE, Germany
- 9h20m **Developing advanced light-trapping structures for back-contact crystalline silicon solar cells by metal-assisted chemical etching**

David M. Pera, Ivo Costa, Filipe Serra, G. Gaspar, Killian Lobato, João M. Serra, José A. Silva\*  
Instituto Dom Luiz - Faculdade de Ciências Universidade de Lisboa,  
Portugal

9h40m-10h00m **Coffee break**

10h00m **Impact of material properties on cell performance II**  
**Bulk and interface defects limiting high-efficiency n-type solar cells**  
Fiacre Rougieux  
School of Photovoltaic and Renewable Energy Engineering, The  
University of New South Wales, Australia

10h40m **Gettering by polysilicon/oxide passivating contact structures**  
AnYao Liu\*, Zhongshu Yang, Jan Krügener, Frank Feldman, Jana-Isabelle  
Polzin, BerndSteinhauser, Sieu Pheng Phang, Daniel Macdonald  
ANU, Australia

11h00m **Alternative Cz Ingot squaring and cell cutting methodology for low  
temperature PV cell**  
Mickael Albaric , S. Harrison, B. Martel, F.Dhainaut, T.Desrues  
CEA, LITEN, Department of Solar Technologies, France

11h40m **Closing**

## POSTER SESSION

- 1 **Rapid Characterization of Surface Damage Region using  $\mu$ -PCD technique**  
Ferenc Korsós<sup>1\*</sup>, Krisztián Dávid<sup>1,2</sup>, András Bojtó<sup>1,2</sup>, Xueqian Dong<sup>3</sup>, Hao Deng<sup>4</sup>,  
Shasha Wang<sup>4</sup>, Chao Du<sup>4</sup>, Xiaobo Chen<sup>4</sup>  
1 Semilab Co., Ltd., 4/A. Prielle K. str., Budapest, Hungary  
2 Budapest University of Technology and Economics, Budapest, Hungary  
3 Semilab Trade Shanghai Co., Ltd., Pudong, Shanghai (201210), P.R.China  
4 LONGi Green Energy Technology Co., Ltd., Xi'an, Shaanxi (710100), P.R China
- 2 **Effect of Germanium Doping in Cast-Mono Silicon Ingots**  
Aravind Subramanian<sup>1,2</sup>, Patricia Krenckel<sup>1\*</sup>, Stephan Riepe<sup>1</sup>  
1 Fraunhofer ISE, Heidenhofstrasse 2, Freiburg, Germany  
2 Albert-Ludwigs-Universität Freiburg, Hermann-Herder-Straße 5A, Freiburg, Germany
- 3 **An attempt to correlate dislocation structures and distribution to macroscale lattice  
rotations in <100> cast-mono ingots**  
Etienne Pihan<sup>1</sup>, Mickael Albaric<sup>1</sup>, Nathalie Mangelinck-Noël<sup>2</sup>  
1Univ Grenoble Alpes, CEA-LITEN, DTS, LMPS, INES, F-73375 Le Bourget-du-Lac, France  
2Aix Marseille Univ, Université de Toulon, CNRS, IM2NP, 13397, Marseille, France

- 4 **Deformation of the crystalline structure in silicon due to carbon contamination and effect on solidification**  
H. Ouaddah<sup>1</sup>, I. Périchaud<sup>1</sup>, G. Regula<sup>1</sup>, G. Reinhart<sup>1</sup>, F. Guittonneau<sup>2</sup>, L. Barrallier<sup>2</sup>, T-N. Tran<sup>3</sup>, J. Baruchel<sup>3</sup>, N. Mangelinck Noël<sup>1\*</sup>  
1 Aix Marseille Univ, Université de Toulon, CNRS, IM2NP, 13397 Marseille, France  
2 Arts et Métiers Institut de Technologie, HESEAM 2, Cours des Arts et Métiers, 13617, Aix-en-Provence France  
3 ESRF—The European Synchrotron, CS40220, 38043 Grenoble CEDEX 9, France
- 5 **Temperature-Dependent Lifetime Measurements Using MW-PS in Contaminated Silicon**  
Sarra Dehili, Cyril Leon, Damien Barakel, Olivier Palais\*  
Aix Marseille Univ, Université de Toulon, CNRS, IM2NP, 13397 Marseille, France
- 6 **Imaging of stress fields and bulk defects in monocrystalline silicon ingots**  
Tamas Brigancz<sup>1\*</sup>, Zsombor Sánta<sup>1</sup>, Árpád Gyurita<sup>1</sup>, István Soczó<sup>1</sup>, Zoltán Kiss<sup>1</sup>, Ferenc Korsós<sup>1</sup>  
1 Semilab Co. Ltd., 4/A. Prielle K. str., Budapest, Hungary
- 7 **Oxygen diffusivity enhancement due to hydrogen- and light-soaking of silicon: A first-principles modelling study**  
Vítor José Babau Torres\*, Paulo David Rodrigues Santos, José Pedro de Abreu Coutinho  
Department of Physics and I3N, University of Aveiro, Campus Santiago, 3810-193 Aveiro, Portugal
- 8 **Formation mechanism of H<sub>2</sub> molecules in Si quenched from high temperatures (and its role in LeTID of solar silicon)**  
Diana Gomes<sup>1\*</sup>, Vladimir P. Markevich<sup>2</sup>, Anthony R. Peaker<sup>2</sup>, José Coutinho<sup>1</sup>  
1 I3N, Department of Physics, University of Aveiro, Campus Santiago, 3810-193 Aveiro, Portugal  
2 Photon Science Institute and Department of Electrical and Electronic Engineering, The University of Manchester, Manchester M13 9PL, United Kingdom
- 9 **Subgrain boundary evolution and interaction with twin boundaries in a directionally solidified thin cast-mono sample**  
Maike Becker<sup>1</sup>, Etienne Pihan<sup>2</sup>, Fabrice Guittonneau<sup>3</sup>, Gabrielle Regula<sup>1</sup>, Hadjer Ouaddah<sup>1</sup>, Guillaume Reinhart<sup>1</sup>, Laurent Barrallier<sup>3</sup>, Nathalie Mangelinck-Noël<sup>1\*</sup>  
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2 Univ. Grenoble Alpes, INES, CEA, LITEN, Department of Solar Technologies, F-73375 Le Bourget du Lac, France  
3 Arts et Métiers, Institute of Technology, HÉSAM Université, 2, Cours des Arts et Métiers, 13617, Aix-en-Provence, Cedex 1, France
- 10 **Identification of Thermal Donor-rich Czochralski wafers using hyperspectral photoluminescence imaging in both n- and p-type materials**  
T. Mehl<sup>1\*</sup>, E. Olsen<sup>1</sup>, I. Burud<sup>1</sup>, J. Veirman<sup>2</sup>, M. Albaric<sup>2</sup>, W. Favre<sup>2</sup>  
1 Norwegian University of Life Sciences (NMBU), Universitetstunet 3, NO-1433 Ås, Norway

2 CEA, LITEN, Department of Solar Technologies, F-73375 Le Bourget du Lac, France

11 **Numerical simulation analysis of the Silicon on Dust Substrate process**

Filipe Serra, José A. Silva, João M. Serra

Instituto Dom Luiz - Faculdade de Ciências Universidade de Lisboa, Campo Grande Ed. C8, 1749-016 Lisboa, Portugal

12 **Optical performance simulation of crystalline silicon substrates randomly textured by metal-assisted chemical etching**

David M. Pera, Ivo Costa, Filipe Serra, Guilherme Gaspar, Killian Lobato, João M. Serra, José A. Silva\*

Instituto Dom Luiz - Faculdade de Ciências Universidade de Lisboa, Campo Grande Ed. C8, 1749-016 Lisboa, Portugal

13 **New cold crucible for silicon single crystal**

K. Zaidat<sup>1,\*</sup>, H. Abouchi<sup>2</sup>, S. Al-Radi<sup>1,2</sup>, X. Han<sup>1</sup>, Fl. Baltaretu<sup>3</sup>, M. Al-Radi<sup>1,2</sup>, C. Garnier<sup>2</sup>, G. Hasan<sup>2</sup>, R. Ernst<sup>2</sup>, and A. Kharicha<sup>4</sup>

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<sup>3</sup>Technical University of Civil Engineering Bucharest, Romania

<sup>4</sup>Christian-Doppler Laboratory for Metallurgical Applications of Magnetohydrodynamics, Leoben, Austria

14 **Controlling silicon laser melting and phosphorus doping at the nanoscale – towards scalable tunnel junctions for tandem solar cells**

K. Lobato, F. Serra, G. Gaspar and JM Serra

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