

INTRODUCTION

The national security situation under which the 12th Sede Boqer Symposium on Solar Electricity Production took place has not improved to any significant extent compared to the way it was at the previous symposium in this series. As a result, we continue to be doubly honored by the presence of foreign keynote speakers who are prepared to overcome their family's fears in order to deliver an up-to-the-minute technological message here at Sede Boqer. Tullio Caselli, from Italy presented a remarkable summary of the manner in which a large-scale solar-thermal system will be used in an Italian city to provide power for a hospital; and Chuck Whitaker, from the USA, presented a comprehensive review of the present status of PV systems in his country and what the probable future directions will be. Hard copies of these presentations are reproduced in the present volume, together with transcriptions of the discussion sessions that followed each lecture.

There was also a surprise item in the guise of an invited talk by someone who has hitherto been unknown in the field of solar energy. Rumors had been rife for sometime that Dov Raviv, of *Arrow Missile* fame, was about to enter the solar arena, and the 12th Sede Boqer Symposium provided him with a first opportunity to present his ideas to the Israeli solar community. A measure of the interest in what he had to say is provided by the length of the discussion that followed his lecture, both of which are also reproduced in this volume.

It is, of course, always a pleasure to acknowledge our sponsors for their generous help in supporting these symposia. This year they were: Ben-Gurion University of the Negev, the Blaustein International Center for Scientific Cooperation, The Israel Power Engineering Chapter of the IEEE, The Israel Section of the International Solar Energy Society, The Israel Ministry of National Infrastructures, The Israel Ministry of Science and Technology, Ormat Industries Ltd, and Solel Solar Systems Ltd.

Last but not least, this symposium could not have been possible without the hard work of the staff of the National Solar Energy Center, specifically, Dov Bukovza, Shoshana Dann, Shlomo Kabalo and Valodya Melnichak. To each of them we owe a big thank you for their preparatory work and for their after-hours attention to details during the symposium.

David Faiman
Sede Boqer, September 2004

Ben-Gurion University of the Negev
The Jacob Blaustein Institute for Desert Research
84990 Sede Boqer Campus, Israel

12th Sede Boqer Symposium on Solar Electricity Production February 23-24, 2004

List of Sponsors:

Ben-Gurion University of the Negev.
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Program

Monday, 23 February, 2004

Morning: Arrival at the **Ben-Gurion National Solar Energy Center**, Midreshet Ben-Gurion.
(50 km / 45 min south of Beer Sheva on route 40; Bus 060)

12:00-13:00 **Registration** (and light refreshment)

13:00-14:45 **Session 1: Solar Energy Conversion Systems**
(Chair: Prof. **David Faiman**, BGU Blaustein Inst., Sede Boqer)

Opening remarks by symposium chair (Formal opening greetings tomorrow)

1. *Miniature solar CHP systems*

Daniel Kaftori¹, Avraham Kribus², ¹Navat Research, Allonei Abba
²Faculty of Engineering, Tel Aviv University, Tel Aviv, Israel

2. *Solar operated organic Rankine cycle units for 0.2 to 10 MWe systems.*
Uri Fisher, **Arik Ring**, Chemi Sugarmen, Ormat Industries Ltd., Yavne, Israel
3. *SunPro - A flat collector for high temperature water and A/C applications.*
Noam Morginstein, Eli Mandelberg and Rami Ezer, Solel Solar Systems, Beit Shemesh, Israel.
4. *Collector certification according to EN-12975, OG-100 and Israeli Standard 579*
Reuven Godali, Israel Standards Inst., Tel Aviv, Israel
5. *Siting considerations for a solar power plant in the Negev*
Aharon Zohar, National Planning & Building Council, Carmei Yosef, Israel
6. *PV applications in Israel.*
Avinoam Levy and Alon Tamari, Solarpower Ltd., Netanya, Israel

14:45-15:15 Coffee Break

15:15 - 16:15 Session 2: Invited Key-Note Lecture and Discussion
(Chair: Prof. **Avraham Kribus**, Tel Aviv University, Tel Aviv)

Solar Thermal Innovation in Italy
Tullio Caselli (Escosolar, Empoli, Italy)

16:15-16:45 Coffee Break

16:45-18:30 Session 3: Energy Conversion and Storage Devices
(Chair: Prof. **Naftali Eisenberg**, Jerusalem Inst. of Technology, Jerusalem)

1. *Influence of high power high capacity flowing batteries on the operation and economy of utility size solar power plants.*
Roy Rosenstreich, MST, Rishon LeZion, Israel
2. *Flowing battery technology and price reduction*
Dov Raviv, on behalf of VRB Power, Vancouver, Canada
3. *Nanoporous semiconductor electrodes for photoelectrochemical solar cells: Design, synthesis, characterization and application*
Arie Zaban, Ilana Abayev, Shlomit Chappel and Ashi Ophir, Dept. of Chemistry, Bar-Ilan University, Ramat Gan, Israel
4. *Improvements in photovoltaic dye cells*
Jonathan Goldstein and Inna Markovich, Orionsolar Ltd., Ariel, Israel
5. *Long term effect of dirt on unattended PV systems in the Negev*
Sergey Biryukov, **David Faiman**, Shlomo Kabalo and Indra Karki, BGU Blaustein Inst., Sede Boqer, Israel

19:00-20:00 Dinner

20:30-22:00 Festive Concert
Hannah Blachman (Cello) and **Eliyahu Zabaly** (Piano)

Tuesday 24th February 2004

07:00-08:00 Breakfast

8:30-10:00 Session 4: Solar Energy Optics
(Chair: Prof. **Aharon Roy**, BGU, Beer Sheva)

1. *Benefits from extreme asymmetric configurations for 2-axis tracking collectors*
Robert Whelan, IDEARS, Gordon, ACT, Australia
2. *High photovoltaic concentration with miniature parabolic dishes and fiber optics.*
Daniel Feuermann¹, Jeffrey M. Gordon^{1,2}, **Eugene A. Katz**¹, Mahmoud Huleihil¹
and Vladimir Melnichak¹, ¹BGU Blaustein Inst., Sede Boqer, Israel,
²Dept. of Mechanical Engineering, BGU, Beer Sheva, Israel
3. *3-D CPC internal surface preparation: A study comparing diamond turning and polished silver coating.*
Jacob Kagan and **Mordechai Lando**, Rotem Industries, Beer Sheva, Israel
4. *Conversion of an astigmatic corrected target aligned solar concentrator into an educational demonstration facility.*
Mordechai Lando¹, Jacob Kagan¹, Eliahu Kalmanzon² & Chanan de Lange³,
¹Nuclear Research Center of the Negev, Beer Sheva, Israel, ² Nitzana Educational Community, Israel, ³Studio de Lange, Tel Aviv, Israel
5. *Flux profile of the solar concentrator, PETAL.*
Sergey Biryukov and Shlomo Kabalo, BGU Blaustein Inst., Sede Boqer, Israel

10:00-10:30 Coffee Break

10:30-12:00 Session 5: Deferred Formal Opening of Symposium
(Chair: Prof. **David Faiman**, BGU Blaustein Inst., Sede Boqer)

10:30-11:15 *Greetings from:*
Joseph Paritzky, Minister
Israel Ministry of National Infrastructures
Atalia (Tali) Rosenbaum, Director General
Israel Ministry of Science and Technology
Prof. **Jimmy Weinblatt**, Rector
Ben-Gurion University of the Negev
Prof. **Avigad Vonshak**, Director
Jacob Blaustein Inst. for Desert Research

11:15 - 12:00 **Special Invited Lecture and Discussion**
A paradigm change in replacing fossil fuel with solar energy
Dov Raviv, MST, Israel

12:30-13:30 Lunch

14:00-15:30 Session 6: Modeling Solar Devices and Systems
(Chair: Prof. **Jacob Karni** Weizmann Inst., Rehovot)

1. *The Transient Response of Poly-Crystal and Amorphous Solar Cell Panels: Some Experimental Investigations*
Michael A. Slonim¹, Alexander A. Slonim², ¹ Dept. of Electrical and Computer Engineering, BGU Negev, Beer Sheva, Israel, ² Dept. of Electrical and Electronic Engineering, Negev Academic College of Engineering, Beer Sheva, Israel
2. *Optimal orientation of bi-facial photovoltaic modules*
David Faiman and Avigail Dolev, BGU Blaustein Inst., Sede Boqer, Israel
3. *Optimizing solar field design for stationary collectors.*
Dan Weinstock and Joseph Appelbaum, School of Electrical Engineering, Tel Aviv University, Tel Aviv, Israel.
4. *Optimization of DC-AC multilevel inverters for hybrid solar power systems in the range 10-100 kW.*
Moshe Averbukh, Negev Academic College of Engineering, Beer Sheva, Israel
5. *The cost of clean energy from fuel-blended solar systems.*
Aharon Roy, Dept. of Chemical Engineering, BGU, Beer Sheva, Israel
6. *Analytical model of electrodiffusion of metals in fullerene thin films.*
Bhim P. Kadle, Isaac Rubinstein and Eugene A. Katz, BGU Blaustein Inst., Sede Boqer, Israel

15:30-16:00 Coffee break

16:00-17:00 Session 7: Invited Key-Note Lecture and Discussion
(Chair: Prof. **Moshe Levy**, Weizmann Inst., Rehovot)

PV systems in the USA: Where they stand and where they should be going
Charles Whitaker, Endecon Engineering, CA, USA

17:00-17:30 Coffee Break

17:30-19:00 Session 8: Solar Cell Materials
(Chair: Prof. **Raoul Weil**, Technion, Haifa)

1. *Charge transport in CdSe quantum dot films*
Shaibal K. Sarkar¹, Hagai Cohen² & **Gary Hodes**¹, ¹Dept. of Materials and Interfaces, ²Chemical Research Support, Weizmann Inst., Rehovot, Israel
2. *Local Probe Investigation of Current Flow in $\mu\text{-Si:H}$?*
Doron Azulay¹, Oded Millo¹, Isaac Balberg¹, J.P. Conde² & V. Chu³. ¹Racah Inst. of Physics, Hebrew University, Jerusalem, Israel, ²Dept. Material Engineering, Inst. Superior Technico, Pais, Portugal, ³INESC Microsistemas e Nanotecnologias, Lisboa, Portugal
3. *Progress in modeling and performance improvement of n+-p-p+Si solar cells with ion implanted p+ layer*

Lev Kreinin, Ninel Bordin, Naftali Eisenberg, Jack Broder, G. Grigorieva, K. Zviagina and M. Kagan. Jerusalem College of Technology, Jerusalem, Israel

4. *High resolution scanning electron microscopy of multi-quantum well solar cells.*

Enrique Grunbaum¹, Zahava Barkay¹, Yoram Shapira^{1,2}, Peter Wilshaw³, Keith Barnham⁴, David B. Bushnell⁴, Ned J. Ekins-Daukes⁴, Massimo Mazzer⁴, ¹Dept. of Physical Electronics, Engineering Faculty, Tel-Aviv Univ., ²Wolfson Applied Materials Res. Centre, Tel-Aviv Univ. Israel, ³Dept. of Materials, Oxford University, UK, ⁴Dept. of Physics, Imperial College of Science, Technology, Medicine, London, UK

5. *Efficiency dependence of the microcrystalline silicon solar cells on the crystalline structure defined by Raman scattering*

Robert Beserman¹, Albert Chack¹, **Raoul Weil**¹, Bernd Recl², Tobias Roschek² & Wolfhard Beyer², ¹Solid State Inst., Technion, Haifa, Israel, ²Inst. fuer Photovoltaik Forschungszentrum Juelich, Juelich, Germany

6. *Understanding polycrystallinity in CdTe/ CdS solar cells: Scanning probe mapping of a single grain boundary/ surface.*

Iris Visoly-Fisher¹, Sidney R. Cohen¹, David Cahen¹ and Arie Ruzin², ¹Weizmann Inst., Rehovot, ²Dept. of Physical Electronics, Tel Aviv University, Tel Aviv.

19:00

Closing Remarks

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I: KEY-NOTE LECTURES

