#3/2002

第 29 回米国電気電子学会
太陽光発電専門家会議
海外出張報告書（速報版）

As of June 24, 2002

Ⅰ．全体事項

1．所属・氏名

東京農工大学工学部電気電子工学科
黒川浩助

2．渡航目的

米国ニューオルリンズにおいて開催される「第 29 回米国電気電子学会太陽光発電専門家会議 29IEEE-PVSC」に出席し，IEA Task8 での検討結果に関する論文を発表するとともに，太陽光発電システム関連分野の発表を聴講・調査する。

3．出張期間・渡航地

平成１４年５月１９日～平成１４年５月２６日　米国ルイジアナ州ニューオルリンズ

4．会議期間・場所

① 5 月 20 日（月）　29IEEE-PVSC：ハイヤットリージェンシーホテル　会議登録・会場下見,
② 〃　29IEEE-PVSC：国際委員会晩餐
③ 5 月 21 日（火）～24 日（金）　29IEEE-PVSC：本講演
④ 5 月 20 日（火）　世界太陽光発電会議 WCPEC-3 プログラム委員会
⑤ 5 月 22 日（水）　世界太陽光発電会議 WCPEC-3 運営委員会
⑥ 5 月 22 日（水）　ファンラン(早朝マラソン)

5．発表事項等

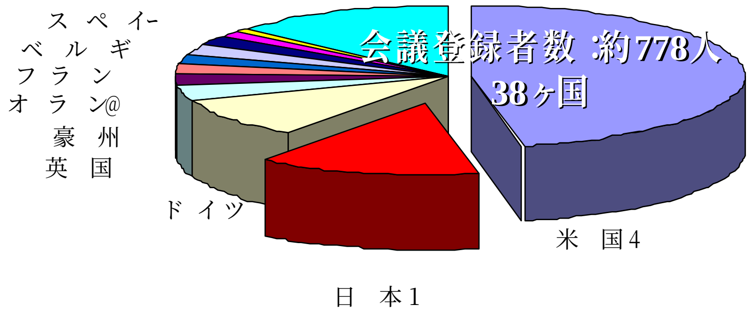
① 5 月 23 日（木）　K. Kurokawa, M. Ito, K. Kato, K. Komoto, T. Kichimi, H. Sugiura, : A cost analysis of Very Large Scale PV (VLS-PV) systems on the world deserts, 5P3.17.
② 5 月 23 日（木）　A. Adiyabat, K. Kurokawa: Performance analysis of portable PV systems based on measured data in Mongolia, 5P3.15.
③ 5 月 23 日（木）　P.S. Pimentel, T. Ozeki, T. Tomori, K. Kurokawa, H. Matsukawa: PV system integrated evaluation software, 5P3.6.
④ 5 月 21 日（火）　Y. Noda, T. Mizuno, H. Koizumi, K. Nagasaka, K. Kurokawa: The development of a scaled-down simulator for distribution groids and its application for verifying interface behavior among a number of module integrated converters (MIC), 5P1.11.

Ⅱ．第 29 回米国電気電子学会太陽光発電専門家会議 29IEEE-PVSC

1．日　時： 2002 年 5 月 20 日(月)～24 日(金)
2．場　所： ハイヤット・リージェンシー・ホテル
3．参加者および発表数

(1) 会議参加者数

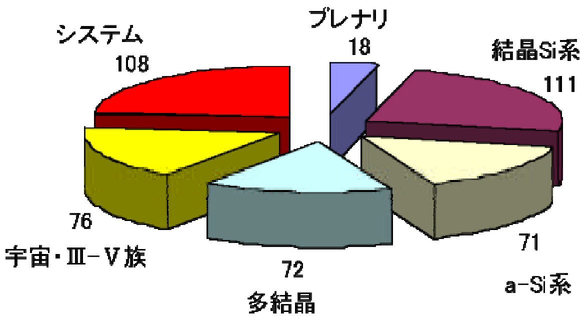
① 会議登録者数：約 778 人
② 会議登録国別統計：参加国数：38 ヶ国



(2) 発表数

① **アブストラクト提出：**540 **件**
② **プレナリ発表：**18 **件**
③ **オーラル発表：**175 **件**
④ **ポスター発表：**233 **件**
⑤ **レイトニュース：**11 **件**

(3) 分野別発表数



プレナリ：18 **件**(3.9%), **結晶** Si **系：**111 **件**(24.3%), a-Si **系：**71 **件**(15.6%), **多結晶化合物：**72 **件**(15.8%), **宇宙・Ⅲ-Ⅴ族：**76 **件**(16.7%), **システム：**108 **件**(23.7%) **合計** 456 **件**

(4) 発表機関別

#	発表機関	国	論文数
1	NREL	US	38
2	Fraunhofer ISE	DE	17
3	Sandia National Lab.	US	15
4	TUAT	JP	9
4	Toyota Tech. In.	JP	9
4	BP Solar	US	9
7	Georgia Tech.	US	8
7	ECN	NL	8
7	Konstanz Univ.	DE	8
7	UNSW	AU	8
11	Spectrolab	US	7

(5) 出展者数

① **43機関から出展**

Able Engineering	GT Solar	PMC - POWER MARK CORPORATION
AEC Able Engineering	HCT Shaping	PV in europe
AMI - Affilated Manufacturers -	Isovolta	Q-Cells

Inc.		
AMI-Presco	Isovolta AG	Radiant Technology Corp.
Amonix Inc.	ITN Energy	Resources Total System Co., Ltd
Astrium	ITN Energy Systems, Inc.	Sandia
Astrium GmbH	James & James	Sandia National Laboratories
Astro Power Inc	John Wiley & Sons, Inc	Sinton Consulting Inc.
Bekaert ECD Solar Systems LLC	Lockeed Martin Space Company	Spectrolab Inc.
BP Solar	Lockheed Martin Space Company	Spectrolab, Inc.
COI - Composite Optics Inc.	Loughborough University	Spire Corp.
DOE Office of Solar Energy Technologies	National Center for Photovoltaics	Spire Corporationn
Dupont Microcircuits Materials	NPC America Corporatio	STR - Specialized Technology Resources, Inc.
Dutch Space	NREL	SUN POWER
ELSEVIER ADVANCED TECHNOLOGY	OCLI	Thales Space Technlogy
Emcore	Optosolar GmbH	TRW
Emcore Photovoltaics	PANAMAC	U.S. Department of Energy
FERRO	PERGAMON	UNI-SOLAR
Ferro Electronic Material Systems PV Energy Systems	Photon Emission Tech., Inc	United Solar Systems
Fokker Space	Pilkington Optronics	WILEY
Global PV Specialists	Pilkington Optronics, Inc	ZAE Bayern

(6) 表彰
① **チェリー賞：**Richard Swanson **氏**(Stanford Univ.→SunPower Corporation)
② **太陽エネルギーメダル賞：**Barnet **氏**
③ IEEE **フェロー：斎藤忠教授（東京農工大学）**
④ **ポスター賞(システム分野)：アマル，黒川（東京農工大学）**

4. 会議総括: Closing Session

プログラム委員長 Rajeewa Arya **氏が以下のように報告した。**

(1) 会議全体事項
① **米・日・欧の政策・プログラムをカバーしたキーノート講演(招待)は好評だった。**
② **米，日，独，伊，豪，蘭の技術成果と** R&D **の方向をカバーした国家計画（招待）は参加者が多く，感謝したい。**
われわれ皆，「太陽」と「雲」の部分を覚えているだろう。
③ **初ののランプセッションには** 120 **人が参加した。よいスタートだった。(注：**2020 **ビジョン)**
④ **初の試みである電子投稿はうまく機能した。**
⑤ **プレナリとオーラルのマルチメディア発表（**OHP**：書画カメラ，写真スライド，**CD**，ラップトップ）はスムースに運んだ。**

[第５分野：システム系のサマリ]
1. **本会議へ提出されたシステム系の論文数が目立って増え，大方のセッションで立ち見の盛況。**

2. 多くのうまくいったケース，あるいは（しばしばアレイ/BOS/負荷間のミスマッチによる）うまくいかなかったケースが報告された。
3. インバータの信頼性は依然として改善の余地がある。最良の報告でMTTFが5年であり，モジュールと同様の20年から25年に改良する必要がある。
4. セルやデバイスの1%～2%の向上のために多くの時間と資源を費やしているのにもかかわらず，モジュールの経時劣化，BOS故障，低品質の設置工事，不十分なBOS要素機器により，一生懸命稼いだPVエネルギーを失っている。

[原文]

Program Highlight

- Keynote Addresses (Invited) covering Policy & Program from USA, Japan & European Union very well received.
- National Programs (Invited) covering technical achievements and R&D direction in USA, Japan, Germany, Italy, Australia, India & The Netherlands were well attended and appreciated.
  We will all remember the SUN and the CLOUDS.
- Rump session attended by ~120, a good start.
- Electronic submissions worked well for our first try.
- Presentations at Plenary & Orals with multi-media (viewgraphs, slides, CD), and laptops) worked smoothly.

[Area 1: Crystalline Silicon Cell]

1. PVMaT contributions towards high volume Si PV module production — significant advances in throughput, performance, and reliability.
2. Growing importance of testing multi-crystalline, ribbon, web and sheet si.
3. Thin Wafers — SiNx back surface passivation with laser fired Al local contacts.
4. advances in Pilot production of thin-film crystalline silicon on glass substrates.

[Area 2: Polycrystalline Thin-Film Compounds]

1. Megawatt level manufacturing facilities set-up by several organizations for CIS and CdTe manufacturing.
2. World record efficiencies of 21.1% (14x) for CIGS, 16.5% for CdTe, 16.9% for $CuInAlSe_2$ reported for lab cells.
3. Surface treatment of CIGS in In-S solutions, advances in modeling and characterization.

[Area 3: Concentrators, Space Cells & Systems and III-V Compounds]

1. Industry reports of ~28% average triple junction in production.
2. Development of solar arrays to operate under conditions of low intensity, low temperature and high-intensity, high temperature.
3. Intriguing novel idea to incorporate use of photonic crystals in conjunction with photovoltaic cells.
4. Significant expansion in Japanese R&D activity in Multijunction and Concentrator Solar cells.

[Area 4: Amorphous Silicon, Microcrystalline Silicon, Nano-Structured Materials and Other Novel Devices]

1. Better understanding of Amorphous and Microcrystalline materials and devices — The importance of amorphous — to - microcrystalline transition region is evidenced by reports on thickness evolution phase diagram.
2. Amorphous Silicon / Microcrystalline Silicon hybrid tandem junction reported with > 14% cell and > 11% module efficie4ncy.
3. Issues concerning manufacturing costs, throughput and in-situ diagnostics addressed. New manufacturing plant of 25 MW capacity to start production in 2 months.

[Area 5: Terrestrial Systems, Applications and Reliability]

1. Significant growth in papers submitted at this conference and most sessions had standing room only!

2. Many of successful and not so successful (often due to mismatch of array/BOS/load) reported.
3. Reliability of invertors still needs a lot of work - reports of best cases were ~5 year MTFF - need to improve it to be 20 to 25 years, same as modules.
4. We spend a lot more time and resources to get 1% or 2% efficiency from cells and modules but then we have module degradation with time. BOS failure, poor installations and insufficient BOS components so much of the hard earned PV energy is lost.

(5) 今後の｣国際会議の予定

[PV in Europe] *Conference and Exhibition on Science, Technology and Application*

- 7-11 October 2002, Rome, Italy

[3rd WCPEC]

- 12-16 May 2003, Osaka, Japan

[14th PVSEC]

- 26-30 January 2004, Bangkok, Thailand

[19th EU-PSEC]

- June 2004, Paris, France

６．聴講記録

本稿は報告者が聴講し関心をもった発表を中心に紹介する。

6.1 オープニング　5月21日（月）

(1) 大会委員長：John Benner 氏(NREL)開会挨拶

① IEEE-PVSC として初めてエレクトニックプレゼンを採用した，フロッピーや CD-ROM，自分のノートパソコンと 3 種のメディアが利用できるようにした。写真スライド，OHP も受付けた。

② IEEE-PVSC は会議エージェントをほとんど使わず, 多くのボランティアにより切り盛りしている。今回は企業側の協力者が前に比べて多くなった。（今回の会議の裏方の名前の紹介。）

③ 今回会議の関連行事として，４つのセミナー，ワークショップ，ランプセッション，ファンラン，バケットクルーズなどの催し物が企画された。

(2) プログラム委員長 Rajeewa Arya 氏（BP Solar）今回の発表論文は約 450 件の論文である。レイトニュースは 12 件提出された。発表上の細かい注意があった。

(3) 会場委員長 Kalejs 氏(ASE America)：今回はパソコンプレゼンを導入したが，いろいろなケースを想定して事前チェックを念入りに行った。プレゼンの注意など。

(4) 展示委員長 Diamond 氏(Spectrolab)：今回の展示では米国企業のほかに，オーストリア，にほん，ドイツなどが参加した。高校プログラムの展示も展示会場の設けた。木曜の午後 3 時までオープンする。

6.2 プレナリ

6.2.1　5月22日（火）Welcome Address，Keynote Addresses，Opening Plenary Areas 1，3，5

(1) プレナリ(火)8:15:　Rymond Sutula 氏（DOE）

DOE:　パブリックサポート　　名前不詳。

① ブッシュ大統領の地球気候変動対策推進計画を受けて，DOE は，エネルギー効率的使用，ゼロエミッション，国家エネルギー政策などを実施している。エネルギー効率的使用計画では産業省エネを中心として 580M$(約 750 億円)の予算がついている。

② 米国の PV ロードマップは意欲的な計画で，2010 年に 2GW，2020 年に 7GW の出荷量を見込んでいる。

③ 長期次世代の多接合薄膜では効率 40%を期待している。

④ 太陽エネルギーによるオンサイト発電で 2010 年までにゼロエネルギーホームを実現する。

⑤ 太陽エネルギーの普及宣伝や教育プログラムも推進している。大学によるデザインコンテストでは 14 大学が参加しており 12 月まで競争する。ニューリーダーシップを育てることは非常に重要である。

(2) プレナリ(火)8:30: 荒谷氏（小川室長の代理）「日本の国家プロジェクトの紹介」

Present Status of Research and Development of PV Technology in Japan. [Slides]

① 生産量の統計グラフからも分かるように，日本の現在の市場の 80%は結晶系である。

② 2005 年にシステムコスト 111 万円/3kW，2010 年には 90 万円/3kW を目標とし。薄膜系や BIPV により実現する。

③ NEDO5 ヵ年計画の紹介（画面の字が小さすぎで不詳)。

④ 先進的太陽電池の目標は 100 円/W である。

⑤ 革新的次世代 PV では 2020 年までに 50 円/W を実現するための 8 項目の基礎研究を実施している。

⑦ 将来の大量普及（future mass deployment）にともない問題となる EMC: 電磁適合性やリサイクルなどの研究開発も実施している。

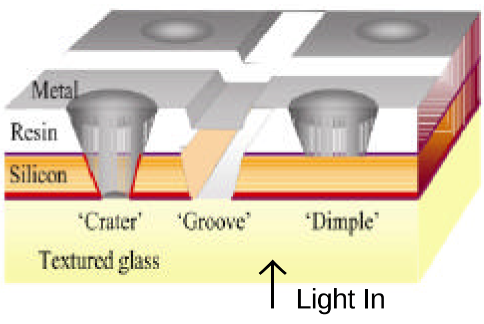
(3) プレナリ(火)8:45: デサント氏「EC の PV 研究開発」

Thierry LANGLOIS d'Estaintot, European Commission: PV R&D in Europe - Past, Actual and Future European Commission Supportive Actions. [Slides]

① 同氏の名前は英国人を意味する。
② EU の機関構造：欧州議会，裁判所，会計監査の 3 権分立
③ Research Dictorate-General の研究プロジェクトについて概括した。DG Research の使命は：
・国際競争力を形成するための研究・技術開発
・EU 各国の R&D の調整，環境，健康，エネルギー，地域開発などの EU 政策の支援
・近代社会における科学の役割に対するよりよき理解の促進
・欧州レベルで実施しているような研究に関して公開論争の奨励
④ 第 5 期基本計画(Framework)1998-2002 は終了しつつある。5 ヵ年で 150 億ユーロの規模である。
⑤ 同計画において，エネルギー関連予算は以下の通りである。
a) 基本アクション：
・再生可能エネルギーを含むクリーンエネルギーシステム　4 億 7900 万ユーロ
・欧州の国際競争力強化のための経済およびエネルギー効率化　5 億 4700 万ユーロ
b) 一般的自然活動　1600 万ユーロ
a)+b)総計 10 億 4200 万ユーロの予算。
PV 予算は a)の中の 2 項目療法に含まれている。
⑥ 2001 年の欧州 PV 市場は 85MW（対前年 40%増），例：スペイン・アイソフォンは 9.5MW →18MW に増産。各国のプロジェクトもうまくいっている。ドイツ，オランダ，イタリア，スペインなど。127MW を 2000 年まで累積設置した。
⑦ 第４期基本計画(Framework)では，1980 年から 1 億 5000 万ユーロ以上の研究予算を投じた。85 件の PV プロジェクトに 8400 万ユーロを支出した。
⑧ 第５期計画 1998-2000 では，52 件の PV プロジェクトに，5800 万ユーロの予算となっており，システム系が少し増額された。
⑨ EU 各国自身のプログラムもある。相互の情報交換のためのネットワークづくりも，PV-NET, PV-EC-NET, PV-NAS-NET によって進んでいる。
⑩ EU の代表的なプロジェクト例の紹介があった。（18 ユーロ/kg，5000ton/年を目標にしたシリコン原料，8g/W，1 cell/秒，~1.1Euro/W の RGSells，薄膜プロジェクト，JRC-ESTI に設置された CIS ファサード，色素セル・プロジェクト）
⑪ 第６期研究計画 2002-2006 の予算要求は，総額 175 億ユーロ要求したが，総額として 162 億 7000 万ユーロが 2 月に認められた。個別プロジェクトの採択は 2002 年の後半に決まるであろう。非核エネルギーは高優先順位が与えられている。
⑫ 太陽光発電の主要研究アイテムとして：低コスト・高品質シリコン原料；とくにウェハ・セルの低コスト化・高効率化をねらった結晶シリコンプロセス技術の最適化；薄膜技術による高効率の大量生産や低コスト化をねらった場合の材料制約への理解；セル・モジュールの革新概念；低コスト化をねらった革新的新概念による要素機器やシステムの５項目を考えている。長期志向を強めたい。
⑬ 関連ウェブサイト：http://www.eupopa.eu.int/common/research, http://www.cordis.eu.lu/

(4) プレナリ(火)9:00：豪パシフィックソーラー社バソール氏「ガラス基板薄膜シリコン太陽電池モジュールのパイロット生産」（Paul Basore）

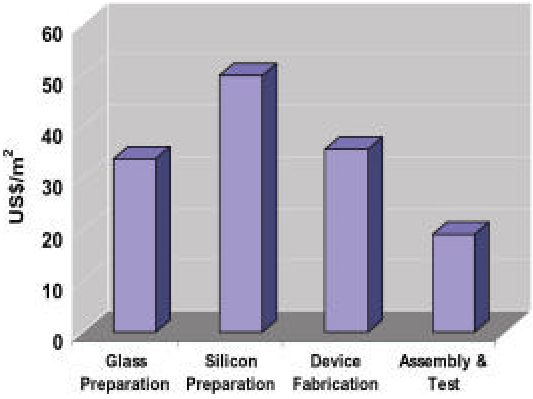
Paul Basore, Pacific Solar Pty Limited: Pilot Production of Thin-Film Crystalline Silicon on Glass Modules. [PDF] [Slides]



① 本講演は超満員であった。
② 図示のような，グルーブ，クレーターおよびディンプル（えくぼ）構造を利用したガラス・オン・シリコンセルのセル分離とセル間配線構造の太陽電池モジュールを開発した。また，その

パターンニング誤差の許容範囲のゆるい金属パターンに関する講演。

③ 製造コストについては，1.4m² のモジュールを10 枚処理できる現在のパイロットラインにおいて，4 シフト 10MW/year とすれば，図に示すように，130 ドル/m² すなわち 1.95 ドル/W で製造可能である。



④ 世界で始めてのこの種モジュールによるシステムを，同社製 MIC-Plug&Power™と組み合わせて設置した。今後 3kW システムをいくつか設置する予定である。

⑤ 効率の掲示変化についての討論あり。

(5) プレナリ(火)9:20：スペクトロラブ社キング氏

R.R. King, et al, Spectrolab: High efficiency space and terrestrial multijunction solar cells through bandgap control in cell temperature. [Slides]

① 3 層構造セルのマッチングにより，27%台の実験的効率が得られた。地上用 100-1000 倍の集光で 34%効率(NREL 測定)となった。

② より高いバンドギャップの GaInP トップセル，低めの GaInAs 中層セル，ゲマと基板の格子整合，広いバンドギャップのトンネル接合が開発のポイントである。

③ 2004 年までに 5 層構造(特許)を実現し，コスト低下，効率向上のためのロードマップを明らかにした。

(6) プレナリ(火)9:40：サンディア研究所ボン氏

R. H. Bonn, et al., Sandia National Laboratories: Technical Requirements for a Next Generation PV Inverter. [PDF] [Slides]

① 現在の市場のインバータは 10kW 以上は少なく，ほとんどは 10kW 以下である。

② 本報告は，PV 用インバーターが抱える技樹的な課題を包括的にレビューしたものである。

③ インバータの信頼性は十分にあがっていない。良好と思われる Trace 社のもの.でも MTTF は 5 年にすぎない。多くは初年で壊れる。技術がよくこなれていないということである。

④ DER(Distributed Energy Resource)インバータに対する技術要求事項がよく定義されていないのではないか？

⑤ ラジオ周波数放射, 高加速度寿命試験(HALT: highly accelerated lifetime testing), 熱設計，パッケージ，低損失磁性体，キャパシタ故障，軽量化，マイコンから DSP へ，など多くの課題を列挙した。（本論文末に参考文献 14 件あり）

6.2.2 5 月 23 日（水）National Programs & Areas 2，4，1，3

(7) プレナリ(火)8:30：新エネルギー国家研究所ウラル氏

PL2.3 Polycrystalline Thin Film Photovoltaics: Research, Development and Technologies

H. Ullal, K. Zweibel, and B. von RoedernNational Renewable Energy Laboratory, Golden, CO

① 多結晶薄膜太陽電池の研究，開発，技術の現状。

② NREL により，薄膜 CIGS が 21.1%，薄膜 CdTe が 16.5%。Global Solar Energy の軽量フレキシブル CIGS モジュールが 8.2%。

③ 薄膜の製品の開発状況は, Antec Solar(CdTe), BP Solar(CdTe), Energy Photovoltaics(CIS), First Solar(CdTe)，Global Solar Energy(CIS)，Siemens Solar Industries(CIS)，Wurth Solar(CIS)などが報告されている。

(8) プレナリ(火)9:10：フランクホーファー社ヴィリク氏

PL2.5 The Fraunhofer ISE Roadmap for Crystalline Silicon Solar Cell Technology

G. Willeke, Fraunhofer ISE, Germany
① Fraunhofer ISE における結晶シリコン太陽電池技術。
② 目標は効率 20%のセルを低価格大量生産ラインに載せること，50μm の極薄ウェハ技術の開発。
③ 結果？：115μm-19.2%の Cz-Si 基板，72μm-20.5%の FZ-Si 基板。

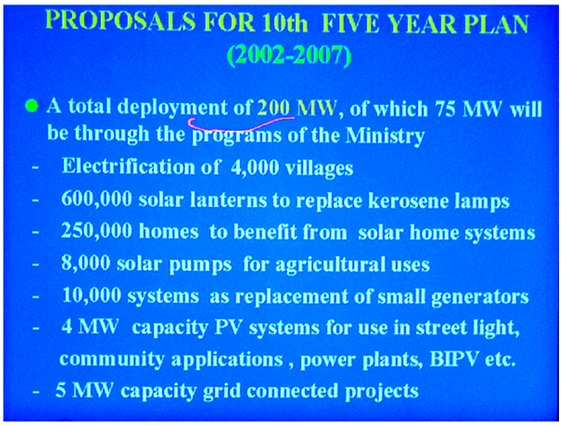
(9) プレナリ(火)9:30：AEC-able エンジニアリング社マーフィー氏
PL2.6 Thin Film and Crystalline Solar Cell Array System Comparisons
D. M. Murphy, M. I. Eskenazi, B. R. Spence, and S. F. White, AEC-Able Engineering, Goleta, CA
① 太陽電池の効率とデバイスの種類（Crystalline Multijunction と Thin Film）による，様々なアレイシステムの性能研究結果。
② 102 の詳細なアレイデザインが計算され，比較された。

6.2.3 5月24日（木）National Programs & Areas 2，4，1，3

(10) プレナリ(木)8:00：カズメルスキ氏
PL3.1 Kazmerski: US PV R&D

(11) プレナリ(木)8:15：インド新エネルギー省サストリー氏
PL3.2 National Program: The Photovoltaic Program in India
E.V.R. Sastry, Ministry of Non-Conventional Energy Sources, Govt. of India, India

① インドにおける政策の発表。
② 発表された 5 ヶ年計画は全容量が 200MW であり，そのうち 75MW は政府の政策である。
③ このプロジェクトにより 4000 の村が電化される。
④ 政府は補助金などの PV 普及への刺激策を行う。01 年度は Rs.896.8Mln の出資，02 年度は Rs.1520Mln の予算額である。



(12) プレナリ(木)8:30：ドイツ ワーグナー氏
PL3.3 National Program: PV Programs in Germany
H. Wagner, Germany
① ドイツにおける政策の発表。
② 10 万屋根設置型 PV プログラムには 1.9%のソフトローンが組まれ，2003 年度までに 300MW が目標である。
③ R&D プロジェクトに Si basic material R&D，Si cell and module development，Si thin film solar cell，Thin film solar cells of compound semiconductors がある。

(13) プレナリ(木)8:45：ECN 太陽光風力エネルギー社シンケ氏

PL3.4 National Program: Development and implementation of PV in The Netherlands
Wim Sinke, ECN Solar and Wind Energy, The Netherlands

① **オランダにおける政策の発表。**
② 2020 **年までに電力の** 17% **を再生可能エネルギーで賄う事を目標に掲げる。**
③ R&D **には結晶系，アモルファスのみならず，微結晶，ポリマー，Ⅲ/Ⅴセル，先進的インバータ設計等を行っている。**
④ **非公式だが，**PV **の目標は** 2020 **年までに** 1500MW **である。**
⑤ **刺激策：屋根設置型太陽光発電システムには** 3.50~4.25€/W **の融資，ネット値または固定関税（**€0.08/kWh**），**NUON **による個人ユーザから**€0.20/kWh **での買い取りの開始等。**

(14) プレナリ(木)9:00：東京工業大学小長井氏

PL3.5 National Program: Thin Film Solar Cells Program in Japan - Achievements and Challenges
M. Konagai, Tokyo Institute of Technology, Tokyo, Japan

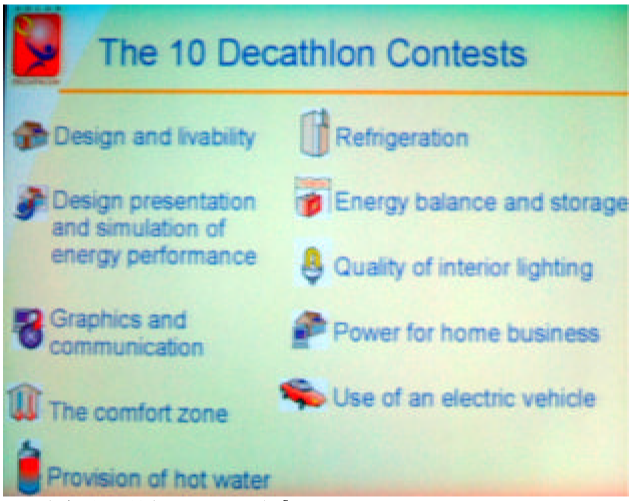
① **小長井先生による日本の政策の発表。**
② **薄膜のプログラムについて調査し，評価した。**
③ **新** 5 **ヶ年計画は** 12.3% **のハイブリッドモジュール，**13.6% **の** CIGS **モジュールがターゲットである。**

6.2.4　5 月 25 日（金）Solar Decathlon & Areas 2，4，5

(15) プレナリ(金)8:00：NREL 社ワーナー氏

PL4.1 Solar Decathlon
C. Warner, NREL, Golden, CO

① **太陽エネルギー利用方法コンテスト。**DOE **より** 10 **種類のコンテスト，一週間にわたるイベント，**14 **チーム参加。**
② **エネルギー効率のよい住宅構造・設計改善，ライフスタイルのスマート化，**BIPV **の発展拡大**
③ **得られるもの：再生可能エネルギー利用技術を学ぶ学生を激励する，増やす，産官学連携に貢献，大学・研究室・学生同士の競争，**R&D **の加速化，マスメディアを通してのアピール効果があった。**
④ 2002 **年の** 9 **月** 19 **日から** 10 **月** 9 **日までワシングトン** DC **のナショナールモールにて展示が開かれる予定。**



(16) プレナリ(金)8:20：シーメンスソーラー社ウィエティング氏

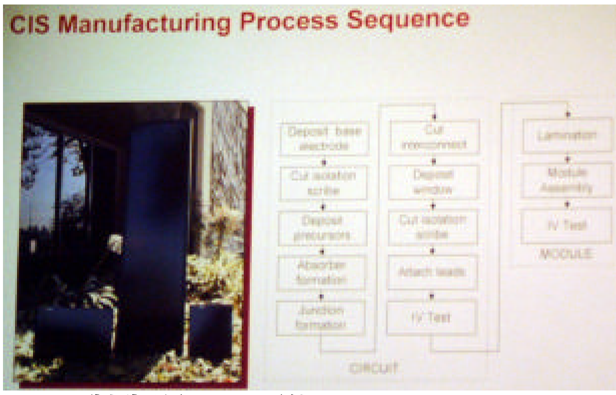
PL4.2 CIS Manufacturing at the Megawatt Scale

R.D. Wieting, Siemens Solar Industries, Camarillo, CA

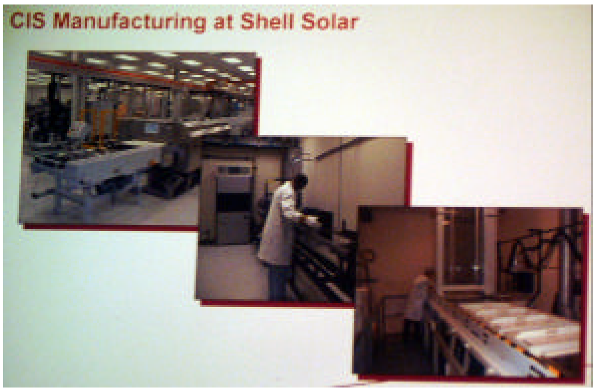
① 薄膜セルのメリットその中での CIS のメリット（使用原料が少量，シリコン原料供給不足などに依存されない，製造過程が少なく自動化に適している，

② 低コストで高効率実現など)，生産量は増え，メガ W スケールに達したことをアピール。Mo フィルム厚さと ZnO 厚さ H_2Se と H_2S の使用量削減し，2x5-foot の基板サイズへ移行，製造ラインの過程改善，加速劣化試験を合格して進む予定。

③ シリコンセル技術，続く改善，その生産量（昨年の製造量：300MW）にまだ競争できないが技術開発を進め，改善していく。



CIS 製造過程その順位

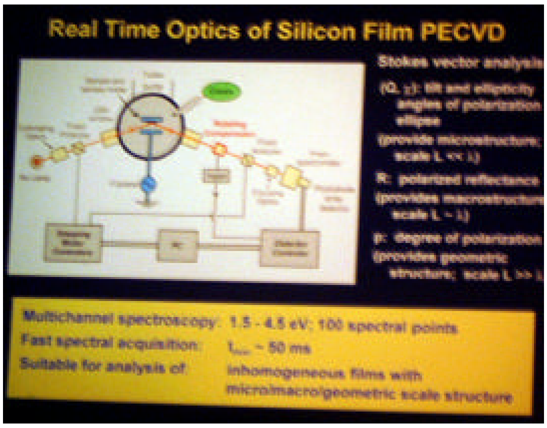


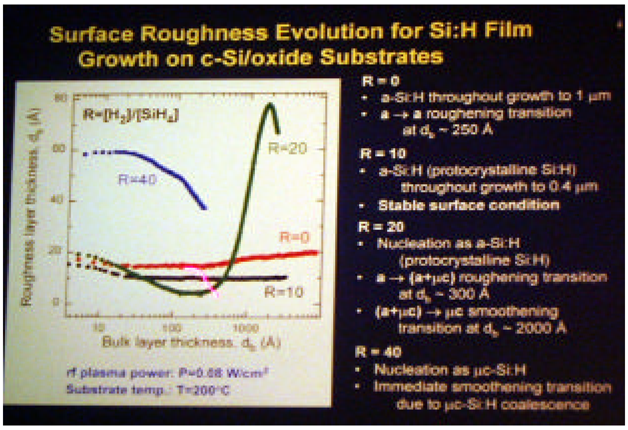
CIS 製造ラインの様子

(17) プレナリ(金)8:40：マテリアルリサーチ研究所フェラウト氏

PL4.3 Thickness Evolution of the Microstructural and Optical Properties of Si:H Films in the Amorphous-to-Microcrystalline Phase Transition Region

A.S. Ferlauto, G.M. Ferreira, C.R. Wronski, and R.W. Collins, Materials Research Institute and Center for Thin Film Devices, The Pennsylvania State University, University Park, PA



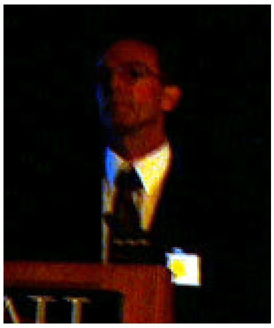


① 実験装置 RTSE の紹介，Si:H 沈着の相図，状態図からの a-Si:H セルの最適化について説明した。

(18) プレナリ(金)9:00：サンディア社キング氏

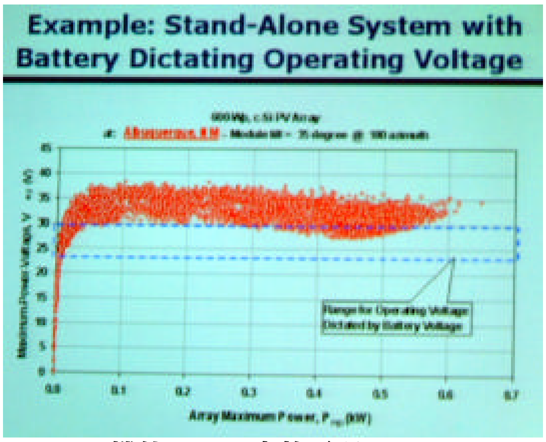
PL4.4 Analysis of Factors Influencing the Annual Energy Production of Photovoltaic Systems

D.L. King, W.E. Boyson, and J.A. Kratochvil, Sandia National Laboratories, Albuquerque, NM

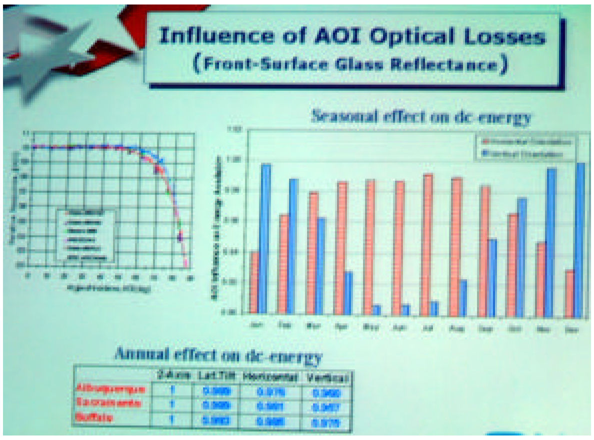


① PV システムの価値を図る尺度：コスト＄, 効率%, W_P, kWh/kW_P, kWh/d, ＄/kWh を定義して，全損失の内訳を示し，評価している。

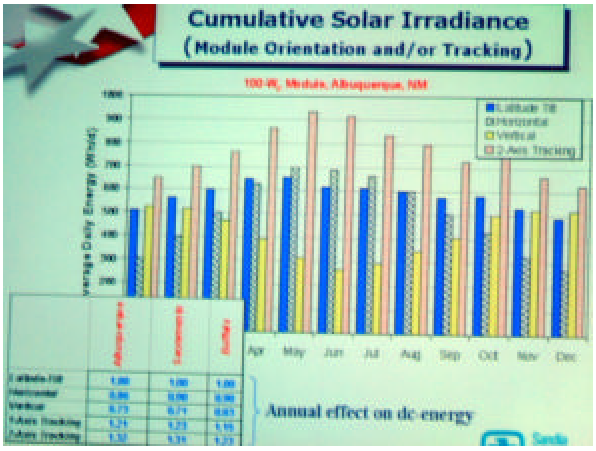
② 独立型 PV システムやハイブリッドシステムの出力と損失のモデリングするなどの研究余地があるという。



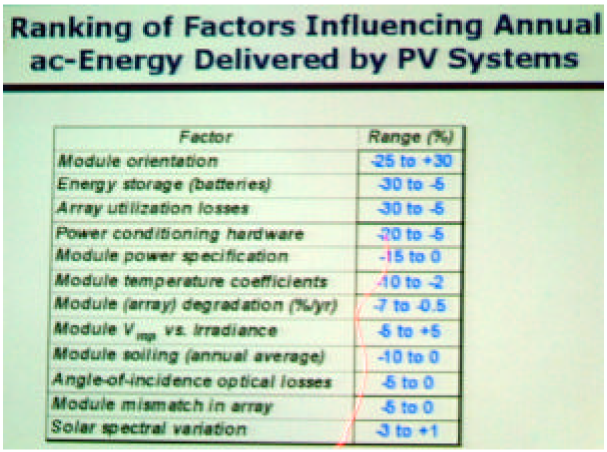
MPPT 機能がない充放電器によって 15〜20% までの DC エネルギーを吸収してない



入射角度による損失効果



固定架台と追尾アレイの積算日射量比較



系統連系 PV システムの損失ランキング

6.2 オーラルセッション

(1) ASE アメリカ社ロゼンブラム氏：EFG リボン

1O1 Kaijs, M.D. Rosenblum, ASE America: PVMaT technology improvements in the EFG high volume manufacturing line.

① PVMaT プロジェクトにおける，EFG リボンプロセスのマスプロ生産技儒開発の報告である。
② ８角形 EFG リボン成長
③ 米 PVMaT プロジェクトのスコープは，生産システム開発，先進型低コストプロセス，フレキシブル生産の 3 つがあげられる。
④ 8 角形シリコンリボンの引き上げが特徴 EFG Octagon Crystal Growth

⑤ 8 週間移動平均の生産収率データを提示。
⑥ 引き上げ後にプラズマジェットでドライエッチして切り離す。CF4 ガスプラズマジェット。50cm 直径の 8 角 EFG リボンから 12.5cmX12.5cm ウェハを切り出す。
⑦ 従来は，切り離しのために YAG Laser を用い，10 cm および 12.5 cm 直径の 8 角リボンから 100mm ウェハを作製している。

(2) Eager, BP Solar: Environtally friendly processes

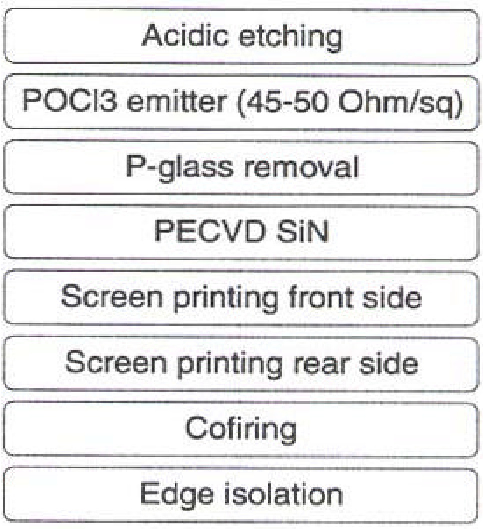
1O1.2 Sandra Eager, BP Solar

① 環境にやさしいサターンセル製造プロセスを開発した。
② 集電電教区形成のために，グルーブの中を銅で無電解めっきした。高電流の電解では銅のスポットが形成されてしまう。
③ 無電解めっきを青酸フリーで実現した。

(3) Hanoka, Evergreen: PV MaT

1O1.3　Evergreen 社 Hanoka 氏

① ストリング・リボン・プロセスにより，8cm×300micron リボンを連続生産。60%コスト低下を実現した。
② グレインサイズは大きい。また，縦方向には縦方向には均質であり，エッチは不要である。
③ セルラインではウェハは常に水平に扱われる。
④ 平均効率 13%，良好なものは 14%に達する。ラボでは 16.2%を示した。
⑤ PECVD によるパッシベーションプロセスを採用。



(4)　Cudzinovic, SunPower: High efficiency bifacial Si

1O1.4　SunPower 社の両面セル：ペガサス・セル

① 裏面を 2 段階メタライゼションでやっていたが，今回はこれを 1 段階にする。
② 電極の直列抵抗が大きくなると FF を下げる。裏面の反射率はアルミが良好である。前面はテクスチャー構造で，HNO3:HF によるエッチ仕上げ。
③ 165 micron 厚を 200 micron とした。FF は下がるが効率は同じ 21.4%を達成。
④ 今回は最終的に 21.6% を達成し, 前回より 0.6%を失ったが, コストを３０%カットできた。

(5)　Kalejs, ASE: EFG_production line

1O1.5　ASE 社 Kalejs 氏＋RWE ソーラー社

① EFG リボンの生産ライン。
② 米国のロードマップでは 2020 年に 7GW の市場。100MW×70 ラインが必要になる。
③ 各種リボンでは，同じ生産規模を達成するための炉の必要数が問題である。
④ 高速レーザーカットを利用した今回生産ラインでは，シリコン材料利用率が 90%で非常に高レベルである。
⑤ 現在，ラインの生産能力を 80MW へ拡張中。

(6)　van Kerschaver, IMEC: Screen printed module fabrication

1O1.6　ベルギーIMEC 社 van Kerschafer 氏：スクリーン印刷を採り入れたモジュール

① スクリーン印刷を採り入れたモジュールを提案。
② 電極パターンの間隔と影の問題を分析した。
③ 11.8W の 100cm^2 のミニモジュールを試作した。

(7)　Sims, AstroPower: Silicon on Ceramic

1O1.7　Astropower 社 Sims 氏：セラミック基板シリコンセル

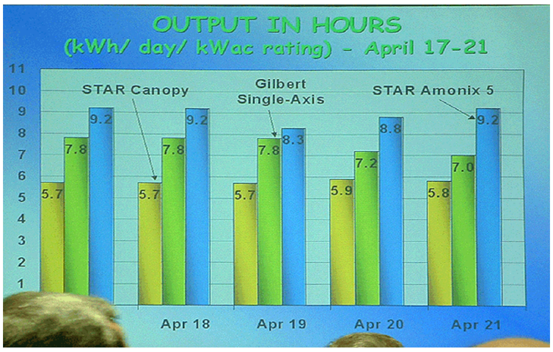
① 10cm×10cm セラミック上に Si を CVD 成長させた。

…

(8) 5O1.1 Initial Results from 300 kW High-Concentration PV Installation

V. Gaboushian, D. Roubideaux, Amonix, Inc., Torrance, CA; P. Johnston, and H. Hayden, Arizona Public Service Company, Phoenix, AZ

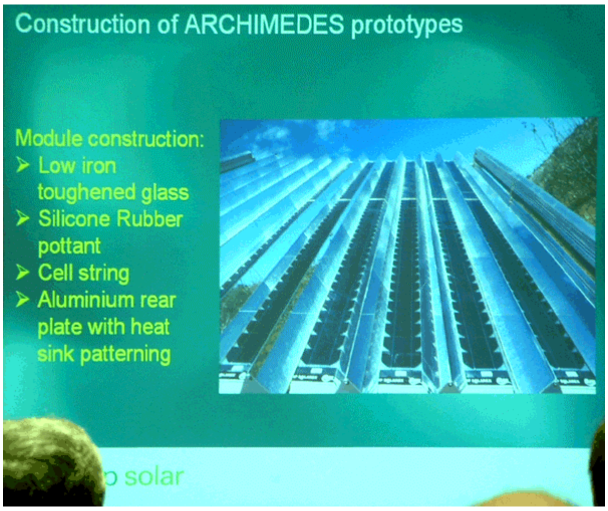
① Amonix 社と Arizona Public Service Company 社のシステムの紹介。
② 固定，一軸追尾システム，一軸追尾集光システム（フレネルレンズ，ディッシュ型）の発電量を比較すると，4 月 18 日においてはそれぞれ 5.7, 7.8, 9.2[kWh/day/kWac rating]となっている。（右図）
③ さらに建築の様子，洗浄の様子などが発表された。



(9) 5O1.2 Concepts for the Manufacture of Silicon Solar Cell Modules for Use in Concentrating Systems Up to 5X

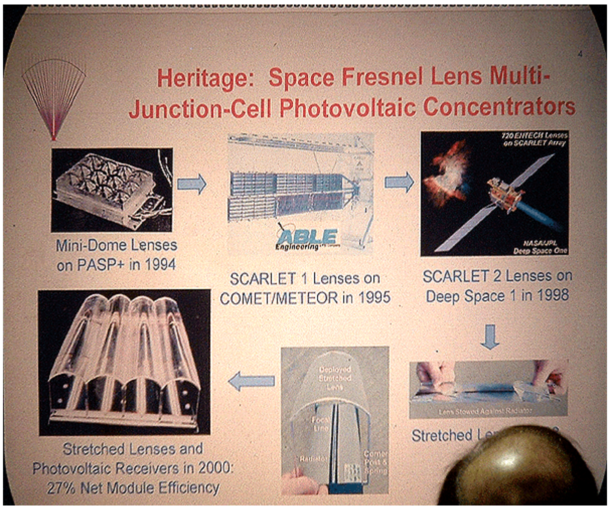
T. M. Bruton, J. Sherborne, K. C. Heasman, BP Solar, Sunbury on Thames, UK; C. M. Ramsdale, Cavendish Laboratory, Cambridge, UK

(1) BP Solar 社の低集光型モジュール(ARCHIMEDES)の紹介。
(2) Laser Grroved Buried Contact Cell を用いた低集光型。集光率による効率の変化，温度による変化，ヒートシンクありとなしについてを報告。
(3) 表面をガラスとフッ素樹脂を比べると，フッ素樹脂の方がコストを約 2 割削減できる。



(10) 5O1.3 Development of Terrestrial Concentrator Modules Using High-Efficiency Multi-Junction Solar Cells

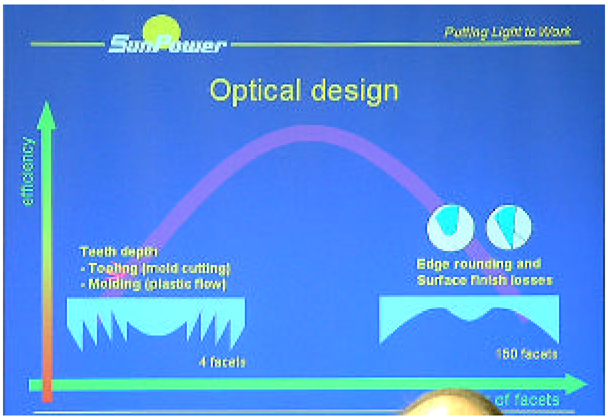
M. J. O'Neill, A. J. McDanal, ENTECH, Inc., Keller, TX; P. A. Jaster, 3M, St. Paul, MN



① 集光用セルを用いた集光モジュールの開発について。
② 陸上用 20×集光システムの長期計測（約 10 年）。
③ 宇宙用 440×集光システムの開発について。

(11) 5O1.4 Recent Developments on the Flat-Plate Micro-Concentrator Module

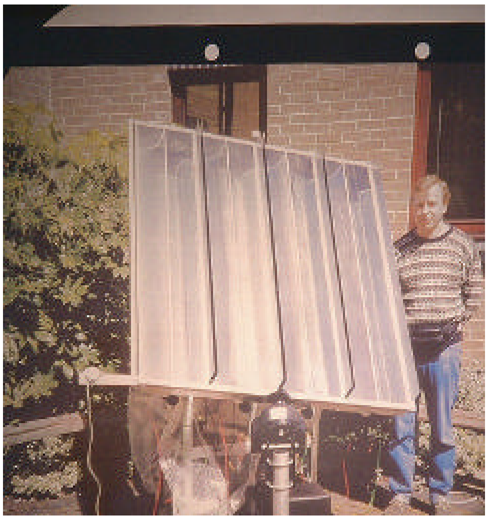
A. Terao, O.C.. Pujol, S. G. Daroczi, N. R. Kaminar, D. D. Smith, K. R. McIntosh, and R. M. Swanson, SunPower Corp., Sunnyvale, CA USA; P. Benitez, J. L. Alvarez, J. C. Mi ･ no, Instituto de Energia Solar, E.T.S.I. Telecomunicacion (UPM), Madrid, SP



① フレネルレンズを用いたセルの開発。
② 右図のようなフレネルレンズを用い，効率と角度の最適化，温度の評価を行う。
③ コストは 3MW/Year の生産規模とすれば，1 割程度下がると評価。

(12) 5O1.5 The Development of Small Concentrating PV Systems

G. R. Whitfield, R. W. Bentley, The University of Reading, Whiteknights, Reading, UK; C. K. Weatherby, Solar Century, London, UK; and B. Clive, Optical Products Ltd., London, UK

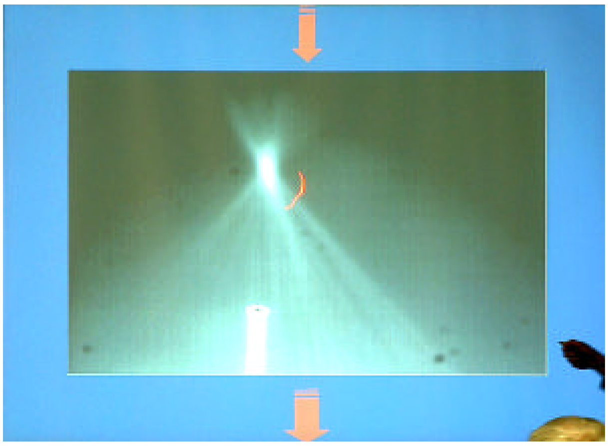


① 様々な小規模集光システムの開発，製造，販売。
② 2m^2 の小型システムは，$1.2/W で製造ができ，日射の良い地点では発電コストは 5 cents/kWh となる。
③ 150-200W のシングルユニットは発展途上国などでの遠隔地においては十分な大きさであり，家やウォーターポンプに適している。

(13) 5O1.7 PETAL: Research Pathway to Fossil Competitive Solar Electricity

D. Faiman, S. Biryukov, and K. Pearlmutter, Dept. of Solar Energy and Environmental Physics, Ben-Gurion Univ. of the Negev, Israel

① 大型集光システムの経済性，光学特性，追尾の精度，光の均質化について。
② 1 年間に 30MW の生産規模（320CPV）とすると，$0.064/kWh となり，設備コストは 1.46$/W となる。
③ モジュール劣化を 1%と 8%ととし，モジュールを 5 年に一度交換，交換する際には 2.5%の効率の向上するとした場合の考察。
④ 光学特性については太陽だけでなく，月，木星を用いた評価。
⑤ 追尾特性の評価には CCD カメラを用いた。正確な追尾システムを提供するためにはツールを同時に提供する必要がある。
⑥ 光の均質化については時間が無く発表中止。



(14) 5O2.1 Impact of Inverter Configuration on PV System Reliability and Energy Production

A. Pregelj, M. Begovic, A. Rohatgi, Georgia Institute of Technology, Atlanta, GA

① インバータの故障を考慮した総出力エネルギーとライフサイクルコストに基づいたインバータの最適構成の検討。
② モンテカルロシミュレーション実運転時の MTTF(mean time between failures)と MTTR(mean time to repair)を用いて故障・修理データをモデル化。
③ PV システムのランダム故障の影響を定量化し，TBF，RT，システム構成による影響を実証。

(15) Osterwald_NREL: c-Si Module Degradation

5O2.2 (5P1.9) Osterwald 氏(NREL): シリコン結晶系モジュールの経年劣化

① シリコン結晶系モジュールの経年劣化の分析。
② UV・時間積で定量化した。
③ FF は不規則に変動する。Ish は 0.71%/年で低下する。
④ 最大出力は 0.5～0.8%／年で劣化するという結果になった。

Module Type	Power (W)	P_{max} Rate (% / year)	I_{sc} Rate (% / year)	V_{oc} Rate (% / year)	FF Rate (% / year)	P_{max} Init. Loss (%)	I_{sc} Init. Loss (%)
Single #1	11	-0.88	-0.59	-0.12	-0.14	-2.75	-2.26
Single #2	16	-0.76	-0.60	-0.14	-0.02	-3.87	-3.34
Poly #1	9	-0.70	-0.25	-0.14	-0.24	-2.34	-2.25
Poly #2	18	-0.53	-0.24	-0.08	-0.08	-2.56	-2.34

⑤ 可視域でのガラスの変化は見られなかった。
⑥ 4 種の EVA のうち 1 種が変色（茶色）。
⑦ Ish が照射 50 時間で-2～-3%劣化する現象もあるが飽和する。

⑧　一般に，単結晶の方が劣化の度合いは大きい。

(16)　Hudson, Xantrex: 3 Phase Inverters

5O2.3　Xantrex 社 Hudson 氏：３相連系型インバータの設計について

①　インバータの信頼性問題は重要な課題になっている。
②　DC/DC converter　ありとなし。
③　効率を正確に測る方法はメーカーに便益。
④　インバータの各パラメータとコストインパクトの関係も大切である。
⑤　MPPT の過渡特性が重要といった。（質問したが，具体的な方法は示さなかった。）
⑥　単独運転は 2 秒以内に切り離し。

(17)　Pelosi, Muri Solar Energy Software: PC software in inverters

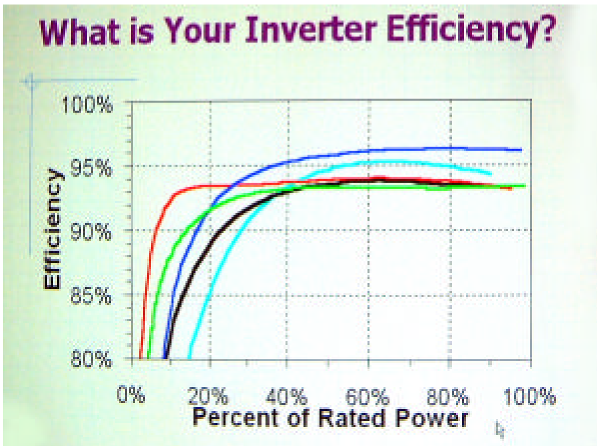
5O2.4　Mauri Solar Energy Software 社 Pelosi 氏：PC software interface

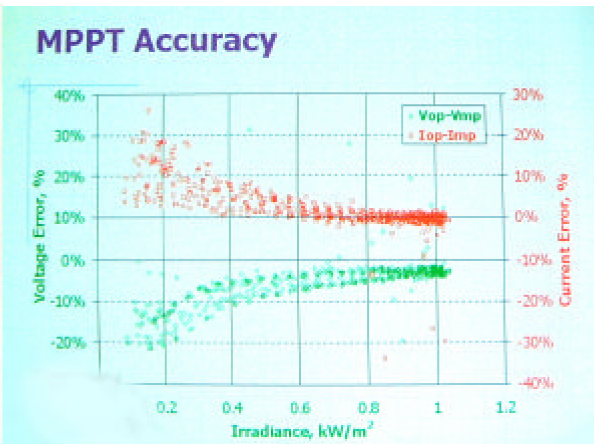
①　インバータの中にソフトウエア・インターフェースを仕込む提案。
②　太陽位置を計算することにより，日射モデル計算。
③　アレイモデリング
④　蓄電池モデリング
⑤　インバータモデリング
⑥　外部回路に 2 個のシャントを設けるだけでよい。
⑦　インバータは情報と制御のキーストーンである。

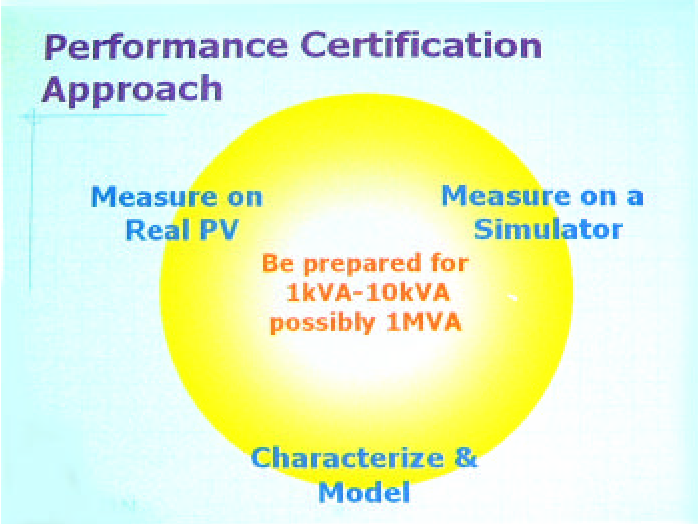
(18)　Whitaker, Endecon_PV: inverter certification

5O2.5　Endecon 社 Whitaker 氏：インバータの認証（同氏は IEC TC82/WG3 の有力メンバー）

①　インバータの認証についてサンディアの Bower 氏の代講。
②　効率
③　MPPT 精度：セル種類によるフィルファクター，温度の影響を受ける。
④　独立型システムでは力率も重要ファクタである。







(19)　Jung, KIER: HF link inverter

5O2.6　Jung 氏　(KIER)：高周波絶縁インバータ

① ４石高周波インバータを開発した。

② HF トランス＋ブリッジ整流ダイオードで低周波 SW４石からなる。

③ 単独運転防止試験

④ Q=R × root(C/L)

⑤ DC/DC コンバータを置いて DC 電流を押し出す。

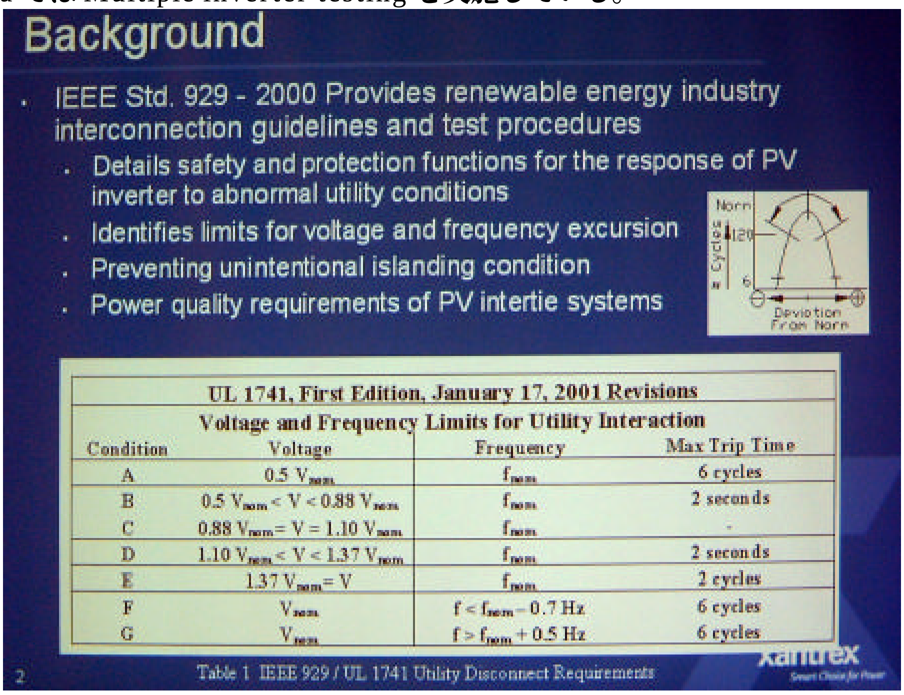
⑥ GTI Inductor を売り潮流の時はオープン。買うときはショート。

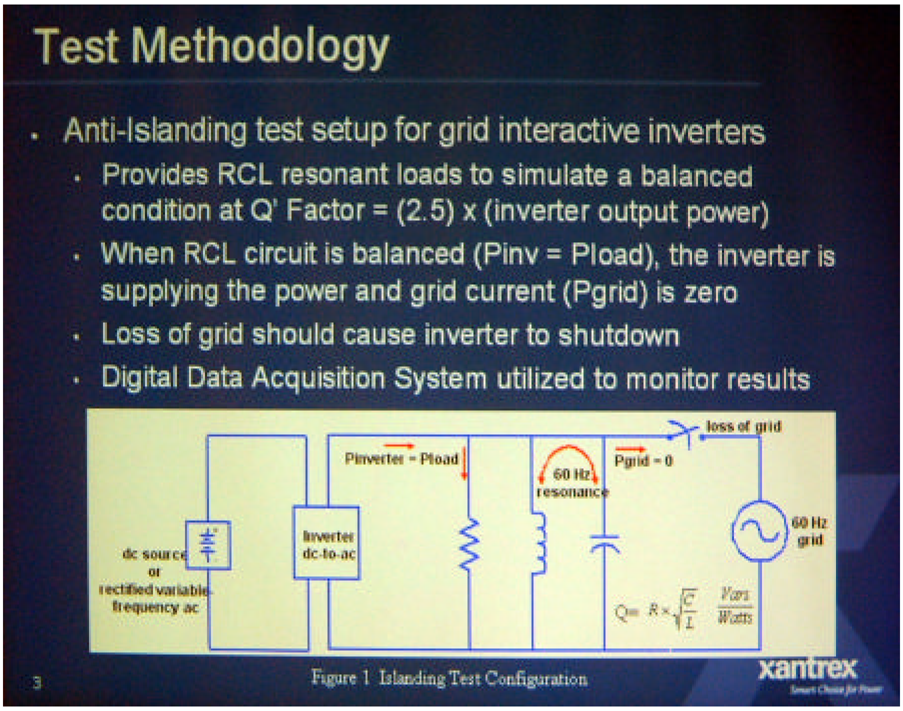
(20)　Hudson, Xantrex: anti-islanding test for IEEE 929-2000

5O2.7　Xantrex Techn.社 Hudson 氏：IEEE の単独運転規格に関して

① IEEE 929-2000／UL1741 は単体のインバータの規格。

② Sandia では Multiple inverter testing を実施している。





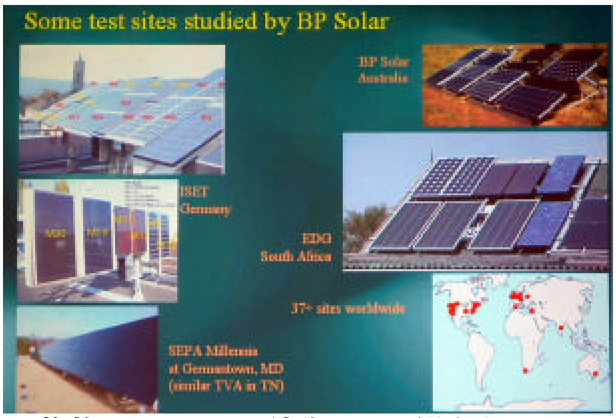
(21) 5O3.1 kWh/kWp Dependency on PV Technology, Balance of Systems Performance and Marketing Watts

S.J. Ransome, BP Solar, Sunbury on Thames, UK; J.H. Wohlgemuth, BP Solar, Frederick

① **アメリカ，南アフリカ，オーストリアのテストサイトで測定された複数モジュールの性能比較し，日射強度，周囲温度に対する効率の分布を図に示している。また** Pmax **不整合の分布も。**

② kWh/lifetime **を伸ばす提案：**Pmax **の定義，**BOS performance，**停止時間，**Vmax Tracking，**誤測定，**Pmax **の変動バンド，日陰，**BOS **損失，これらの性能改善・損失削減，最適設計が必要と強調。**

③ www.bpsolar.com **にアクセスし，**Ransome **で検索する事が出来る。**



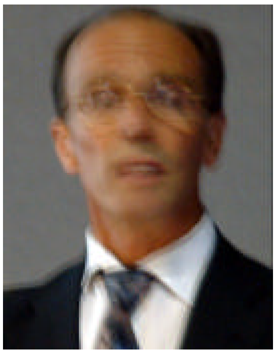
複数モジュールの試験サイト配置図。

(22) 5O3.2 PV Hybrid System and Battery Test Results from Grasmere Idaho

T. Hund, Sandia National Laboratories, Albuquerque, NM; S. Gates, Idaho Power, Boise, ID

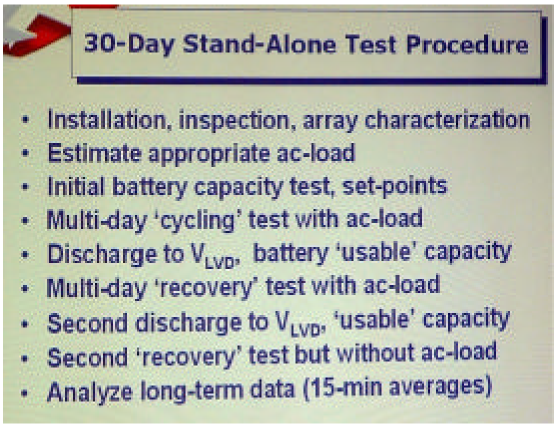
① PV:75kW, ディーゼル:210kW, 蓄電池:240V, 3ストリングで 6000Ah, 1.44MWh が Idaho Power によって設計で 1996 年に設置。
② 充電モードを次のように決定：Bulk-chargeVpc=2.35V　3h，Taper-charge or Boost charge 6 日毎に Vpc＝2.55V　5-6h，一日平均過充電 111%，電解液の比重測定と 2 年後との比較，蓄電池の温度管理。
③ 360 セルから 2.5 年で一つのセルが寿命終止。電解液の補充 6 ヶ月ごとに必要。
④ サイクルライフ DOD50%まで 3000 回で 6～10 年，初期コスト～＄100/kW，発電コスト～＄0．1/kWh，ディーゼル 9h/日　＄0.5/ﾘｯﾄﾙ，Low battery maintenance，蓄電池のメンテナンスが欠かせないと主張する。

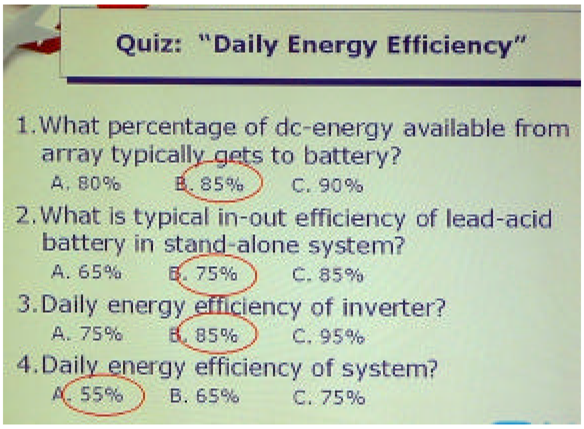
(23) 5O3.3 Experimental Optimization of the Performance and Reliability of Stand-Alone Photovoltaic Systems



D.L. King, T.D. Hund, W.E. Boyson, J.A. Kratochvil, Sandia National Laboratories, Albuquerque, NM

① 独立型 PV システムの性能・信頼性の実用的最適化。30 日試験，アレイの各角度での実出力電力量，そのレイティング，蓄電池初期テスト，境界電圧設定，複数サイクルテスト，深い DOD からの回復試験，実用容量,その他の解析。
② アレイ出力の 15-20%が使われてない 最大電力の不整合損失, 蓄電池の定格容量の 85%が実用的容量といえる。V_{LVD} と V_{VVR} が信頼性を決定する。





③ PV システム出力係数 0.55%であったがこれを 75%までアップできる。30 日試験方法を開発し，システムの性能を把握できるようにしたが，劣化評価などに関する研究がまだ必要。システム効率に関するクイズまで出された。

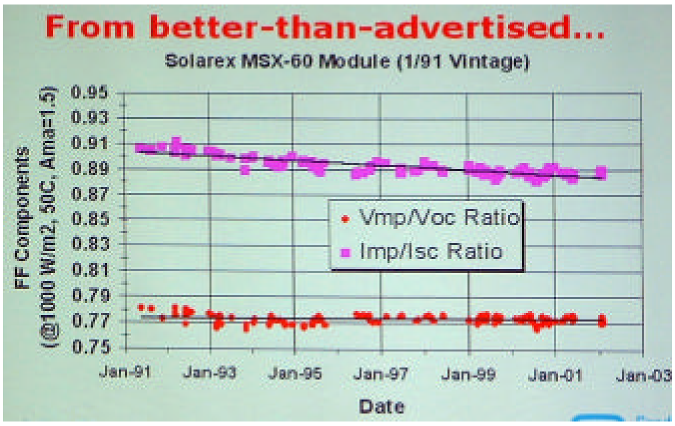
(24) 5O3.4 Comparison of PV Module Performance Before and After 11 Years of Field Exposure

A.M. Reis, N. T. Coleman, M.W. Marshall, P.A. Lehman, C.E. Chamberlin, Schatz Energy Research Center, Humboldt State University, Arcata, CA

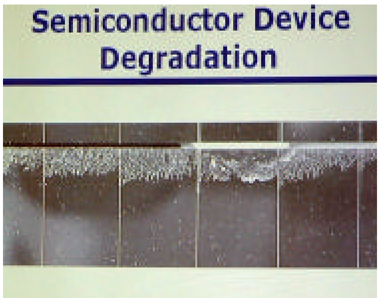
① Solar Hydrogen Project　**太陽エネルギーから水素製造, 燃料電池技術に関する研究プロジェクトで** 1990 **年から運転開始。**
② ARCOM-75 **型の** 192 **枚単結晶** Si **モジュール。サイトは海から** 150m **距離に設置されている。**11 **年後の開放電圧**　-0.22%, **短絡電流**　-6.38%, Pmax　-4.39%**減少が測定された。**
③ EVA encapsulant Discoloration – EVA **の不透明化,セルが青色に変化,** , Delamination- EVA **とセルの剥れ**, hot spot **ホットスポットが出来ている。**

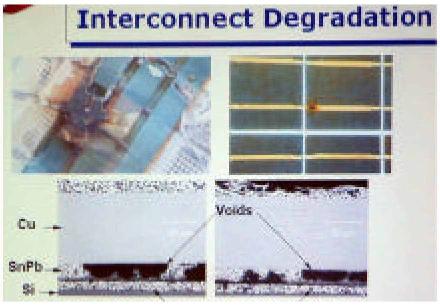
(25) 5O3.5 Commonly Observed Degradation in Field-Aged Photovoltaic Modules

M.A. Quintana, D. King, Sandia National Laboratories, Albuquerque, NM; T. McMahon and C. Osterwald, NREL, Golden, CO　Michael Quintana Sandia lab.



① www.smud.org/pv/pv_pioneer1.html **を背景に引用。短絡電流の劣化を図に示した。**
② **多種類のモジュール実験結果から劣化予想が困難, 種類によって異なる。** http//ieee.dct.supsi.ch/PV/Results/Tested_modules.html **を参考に。**

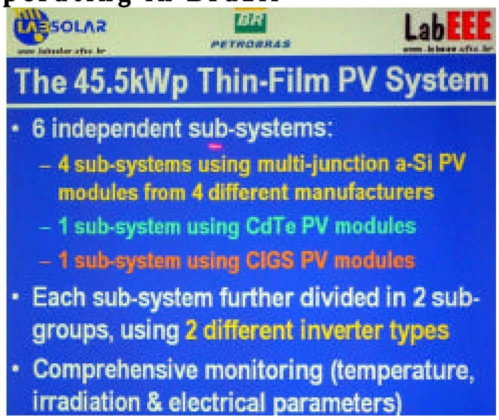




③　これらの劣化原因は機能性能に次の影響を与える：　性能低下・損失増加，安全上の問題，直列抵抗増加，動作中のセル温度上昇，サビ corrosion，出力電流低下，熱発散低下 poor heat dissipation,焼けど burn sadhesion- 接着，Moisture intrusion- 湿気浸入。
④　モジュールの劣化を一般モデル化すれば寿命の予想と取替えコストを計算できるというメリットがある。

(26) 5O3.6 The PETROBRAS 40kWpAC Thin-Film Grid-Connected PV System: A Comparative Study of Four a-Si Module Types Operating in Brazil

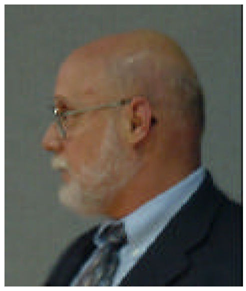
R. Ruther, I.T. Salamoni, LabEEE, Depart. De Engenharia Civil; A. A. Monenegro, LABSOLAR, Dept. de Engenharia, Brazil; A. J. G. da Silva, and R. G. Araujo, PETROBRAS, CENPES, Rio de Janeiro, Brazil



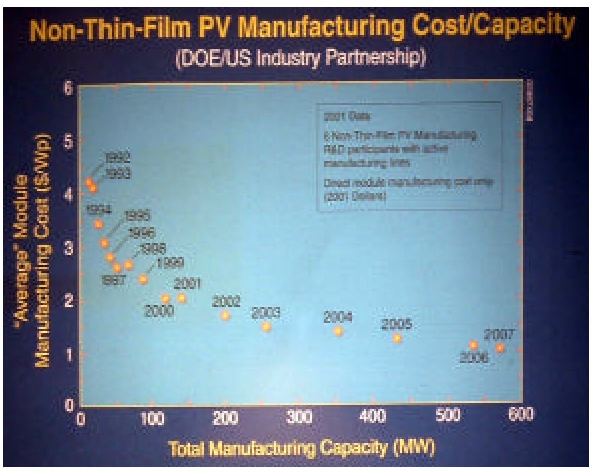
①　総合容量が 45.5kW になる，6 種類の薄膜モジュールに比較試験を行う目的で設置，ブラジルの日射量分布図作成に協力している。
②　全ての部品が輸入品であったため国内製造を検討，他には 2 箇所のガソリンスタンドに PV, BIPV を設置している。

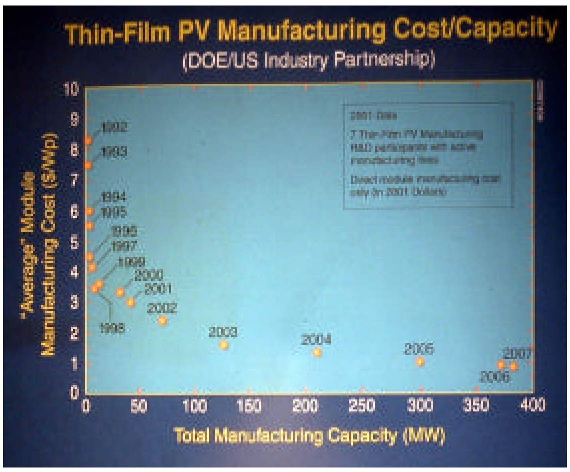
(27) 5O3.7 PVMaT Advances in the Photovoltaic Industry and the Focus of Future PV Manufacturing R&D

R. L. Mitchell, C.E. Witt, H.P. Thomas, M. Symko-Davies, NREL, Golden, CO; R. King, US DOE, Washington, D.C.; D.S. Ruby, Sandia National Laboratories, Albuquerque, NM



①　PV 産業を促進するため：製造過程の改善，製造コスト削減の促進，実質的な PV 市場拡大の基礎づくりが必要。

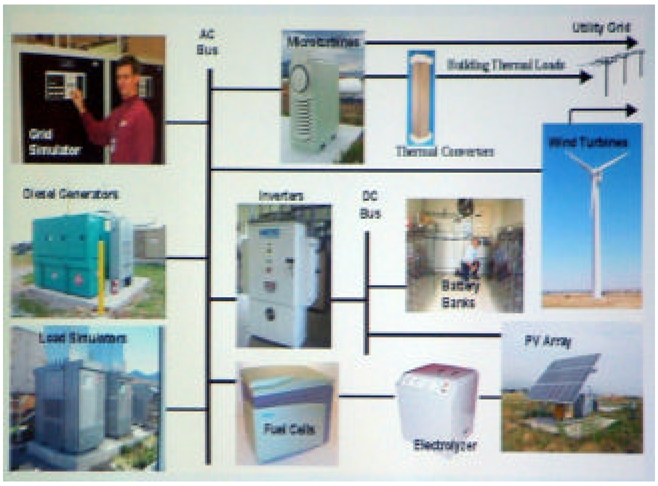




② **プログラムの戦略：競争的政府調達に基づいた製造技術における** R&D **の支援処置，政府・産業の複数年・費用共同負担する協力体制作り，産業の共有問題に対する** R&D **の支援チーム**。
③ PVMaT '98 Award, In-line Diagnostics and Intelligent Processing in Scale-Up Manufacturing 1. **システム・周辺機器技術　２．モジュール製造技術**。
④ PV **製造のコスト・容量経緯と** 2007 **年までの予想を図に示した，結晶と薄型セルの製造割合も，**R&D **の資金調達経緯**。

(28) 5O4.1 Distributed Power and the Status of the IEEE P1547 Draft Standard for Interconnecting Distributed Resources with Electric Power Systems

H. Thomas, T. Basso, National Renewable Energy Laboratory, Golden, CO



① **再生可能エネルギーにはたくさんの利点がある。それを活用するには技術的に：複数分散電源システムの相互接続に関する基準と規約，その合理的統合設計，規定・制度上では：電力規定，地域制，認可制度等。**
② IEEE P1547 **基準** '99 March 18, draft9 2002 **年** 6 **月４日に会合の予定。基準の統一化，技術的要件最小化，** Universalization**，多機能化，連系・同期。**

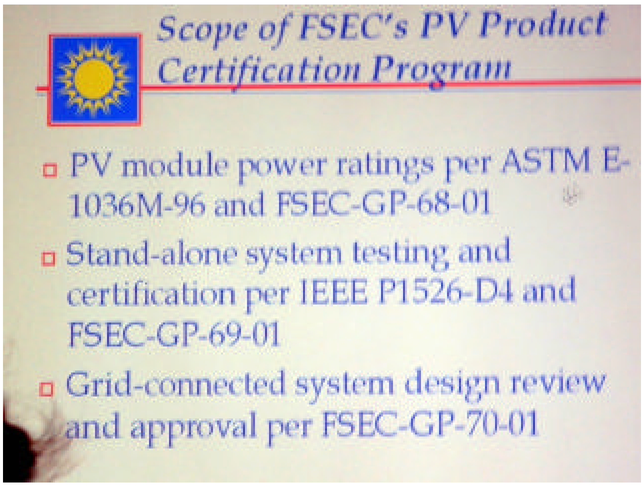
(29) 5O4.2 PV Power Systems, The 2002 National Electrical Code, and Beyond

J. Wiles, W. Bower, Southwest Technology Development Institute, New Mexico state University, Las Cruces, NM

① 2002 National Electrical Code（NEC）, Article 690 **への訂正について説明。**
② **蓄電池に絶縁ボクス，ケース，棚の必要。接地，** 2005 NEC **に訂正検討，インバータの接地方法，** DC **の絶縁，過電流，アレイと蓄電池の容量のバランス，過充電防止機能等が明確になるようにする。**

(30) 5O4.3 Photovoltaic Test Laboratory Accreditation and Product Certification

G. Atmaram, Florida Solar Energy Center, Cocoa, FL

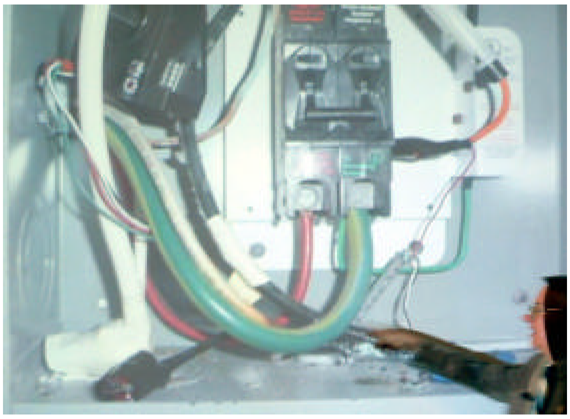


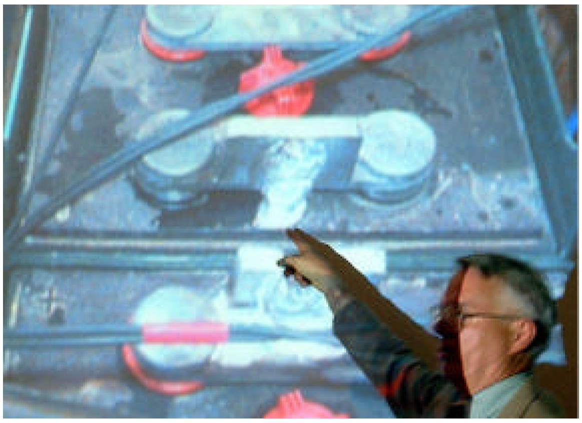
① **問題：多くの** PV **システムは期待した性能が出ないため一般ユーザの信頼性が薄れる。**
② **原因：モジュールの定格出力がでない，試験・認証されてないモジュール・**BOS **が使用される，システムの設計・設置の不備。**
③ **解決：**BOS **の設計改善，**PV **製造の品質改善，設置の品質改善，システムの設計改善そして** PV **試験**Lab **などにおける試験・認証が必要。**
④ **ユーザが望む** PV **商品を提供し市場を拡大するのに長期保証，サポート契約，商品認証等が不可欠。**
⑤ FSEC PV **試験** Lab **が** AZLA **によって設立，特殊試験設備を揃えており，国際的に活躍するという。**

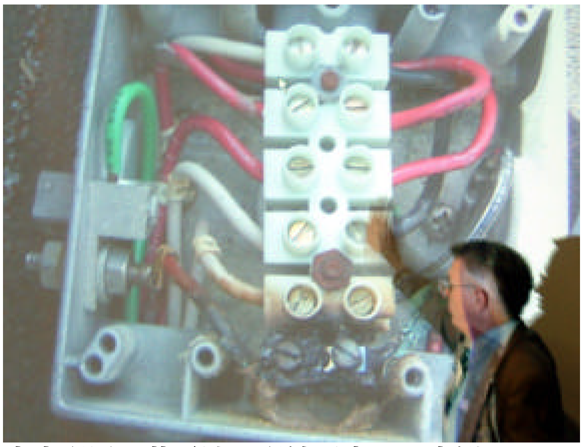
(31) 5O4.4 PV Installations, A Progress Report

J. C. Wiles, B. Brooks, B. Schultze, New Mexico State University, Las Cruces, NM

① 複数の PV システムサイトに設置工事の品質チェックを行った結果報告であった。
② システムの安全性，各機器の配置，配線ケーブル・導線の接触品質を点検した結果，非常よく設置され基準を合格したシステムが半分くらいで残りは基準に合格できなく，何らかの不備があった。
③ 以下の写真のような導線接触不良，蓄電池の配線不良など発見された。設計・設置の品質改善が求められていると主張した。





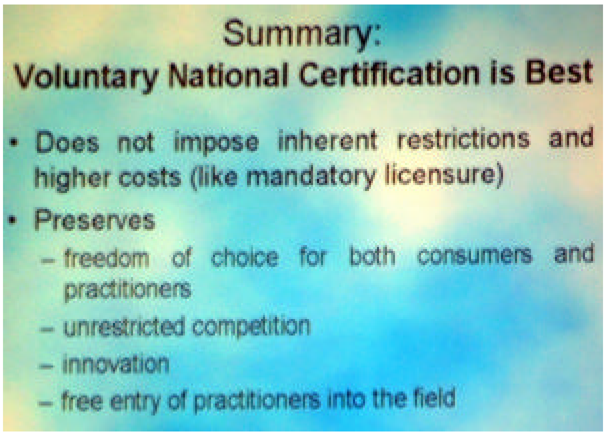


導線の接触不良・接続箱のケーブル高密配置・蓄電池の配線不良など事例

(32) 5O4.5 National Practitioner Certification Versus Disparate State Requirements

M. Fitzgerald, W. Parker, Institute for Sustainable Power, Highlands Ranch, CO; J. Weissman, IREC, Latham, NY

① この発表では PV 産業におけるあらゆる規制（将来における影響を含めた）について費用・便益分析した結果が報告された。
② 認定制度は消費者の選択が保証し，需要を増やす半面，業者間の自由競争性を失い，PV 産業の発展を妨げる，コストも掛かる。
③ National Voluntary Certification（自発的認証制？）が最も良く，認定制度ようにコストが掛かることも自由競争力を失うこともないという。

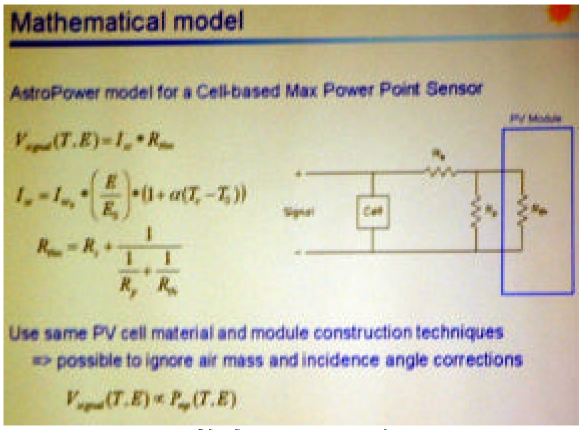


(33) 5O4.6 Design of a Max Power Point Sensor for Photovoltaic Systems

J.E. Schripsema, A.J. Holmes, M.A. Johnson, N. Hafycz, and L.M. Koschier, AstroPower, Inc, Newark, DE

① 低コストの Pmax 電力センサを作成し，数式モデルを立てフィールドテストによってセンサのモデル式の妥当性と誤差を評価した。
② 晴天日・曇天日試験でも誤差が 2%以内に収まっていた。
③ 日射強度と温度依存度を改善したという。

挿入式の簡易センサ

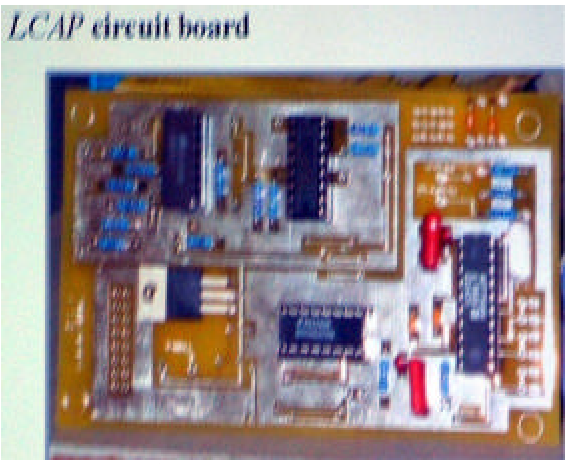


数式モデリング

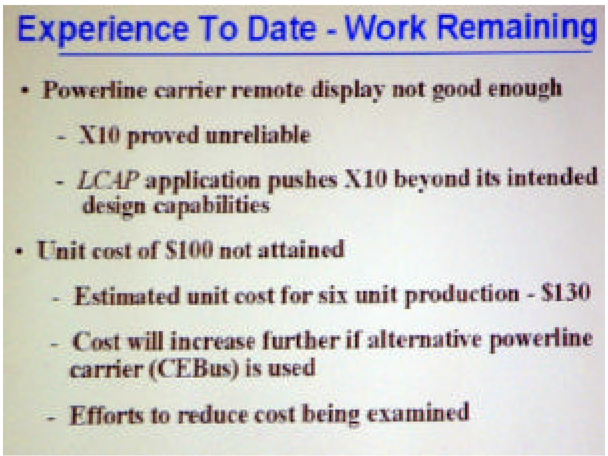
(34) 5O4.7 Low Cost AC Power Monitor for Residential PV Support

A.L. Rosenthal, J. Mani, M. Kachare, New Mexico State University, Las Cruces, NM

① PV システムが普及する中，利用者がシステム出力性能を把握できるように，計測装置を装備するとコストが掛かるためメーカはサポートしてない。そこで利用者が手軽に LCAP Program(Low Cost AC Power Monitor)を 2001 年 12 月から開始，目標は IEC1036 一級クラス，マイコン・ディジタル制御・データロッギング・無線通信，一般ユーザが設置できる，リモートコントロール，マニュアル付き，＄100 以下をねらう。
② Jackrabbit BL1800 マイコンを使用，自動同期，リアルタイム表示，6 セット設置済み，実験中。
③ コスト目標は達成できず。



LCAP の回路ボード（Jackrabbit BL1800 使用）

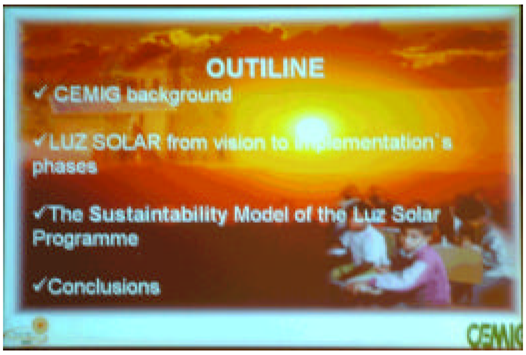


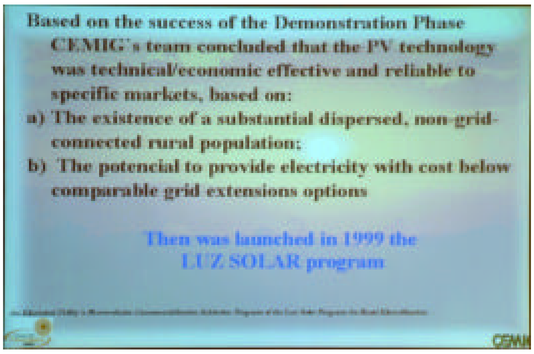
＄100 以下の目標に達成できず課題が残る

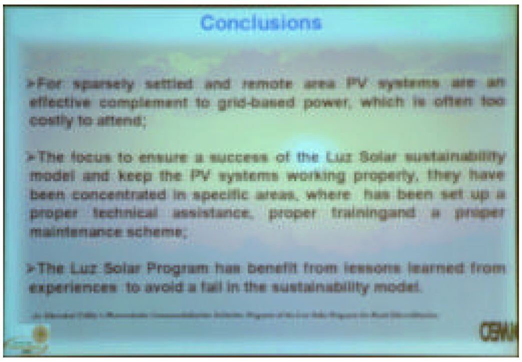
(35) 5O5.1 A Utility's PV Commercialization Initiative: Progress of the LUZ Solar Program for Rural Pre-Electrification

A.S.A.C. Diniz, F.W. Carvalho, E. Franca, J.L. Tome, M.H. Villefort, C F. Camara and M..B. Delgago, Companhia Energetica de Minas Gerais-CEMIG, Belo Horizonte, Brazil

① ブラジルの中部で行われている農村地域の独立型システム電化プロジェクト（LUZ Solar）の概要，進捗，及び評価。



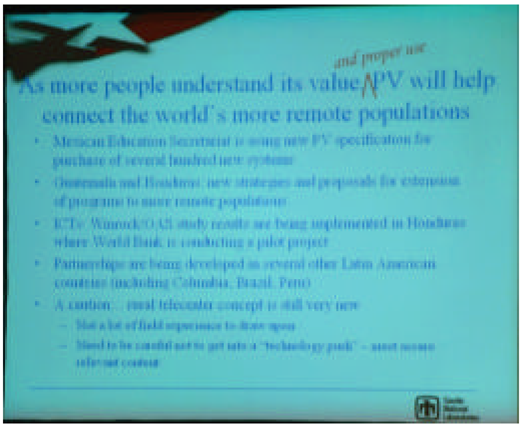




(35) 5O5.2 Meeting the Challenges of Using PV for Rural Internet Connectivity and Distance Education in Latin America

C.J. Hanley and M.P. Ross, Sandia National Laboratories, Albuquerque, NM; R. Foster and G. Cisneros, New Mexico State University, Las Cruces, NM, C. Rovero, and L. Ojinaga, Winrock International, Arlington, VA; and A. Verani, Enersol Assoc., N. Chelmsford, MA

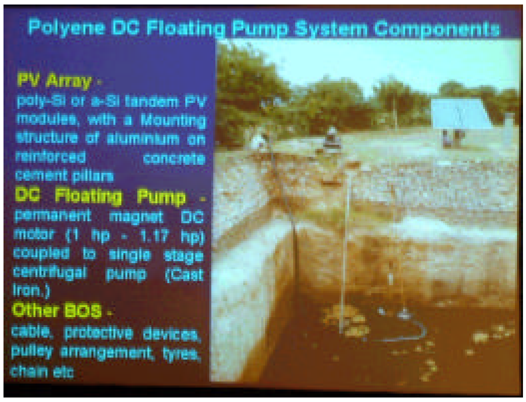
① Sandia のプロジェクトで，中南米の農村地域でのインターネット接続及び，遠隔距離教育システムのための PV システム（パイロットプロジェクト）の実施結果および評価。



(36) 5O5.3 Solar PV Water Pumping Comes of Age in India

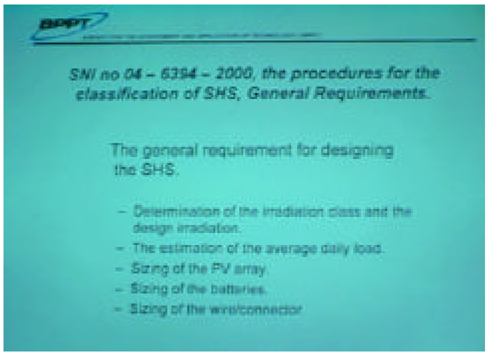
T.S. Surendra, Suryovonics, Ltd., Hyderabad, India; S.V.V. Subbaraman, Polyene Group, Chennai, India

① インドの農村地域における，独立型の WaterPumping 用システム導入の経済的なアプローチ，LCC（ライフサイクルコスト）分析。



(37) 5O5.4 Indonesian Effort to a Better Quality of Solar Home System

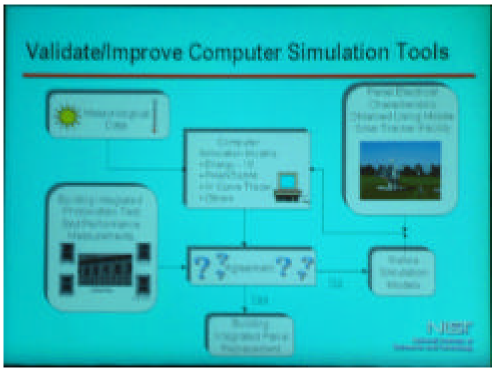
A. Sudradjat, Center for the Assessment and Application of Energy Conversion and Conservation Technology, Indonesia



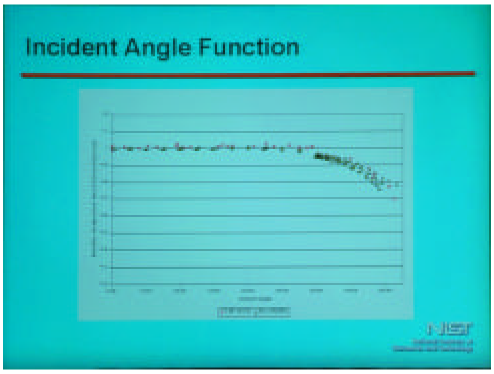
① インドネシアの証明用 SHS の運転, パフォーマンスの評価の結果。
② 現在 50000 件設置してある。

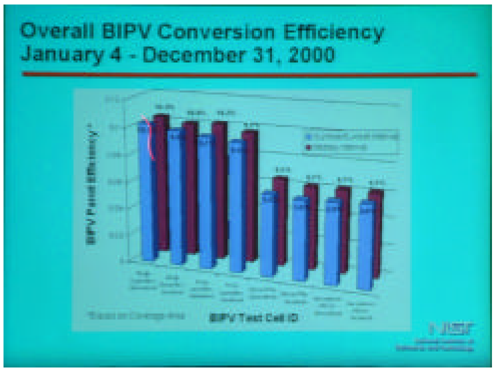
(38) 5O5.5 Performance and Characterization of Building Integrated Photovoltaic Panels

A.H. Fanney, B.P. Dougherty, M.W. Davis, National Institute of Standards and Technology, Gaithersburg, MD



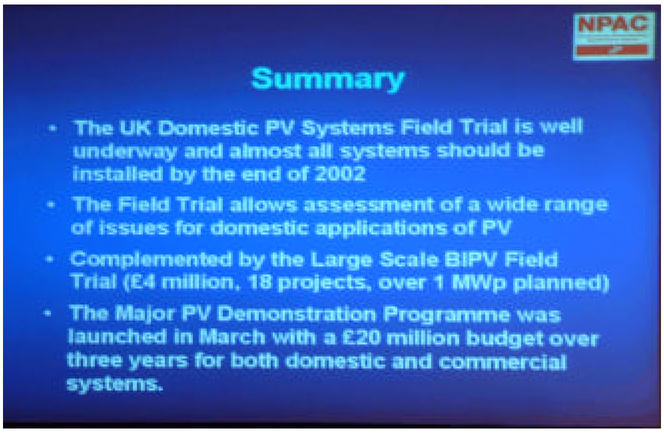
① アメリカの NIST（National Institute of Standards and Technology）の BIPV の試験データの提供
② システム出力予測シミュレーション・ツールの改善と評価





(39) 5O5.6 The UK Domestic Photovoltaic Systems Field Trial – Objectives and Initial Results

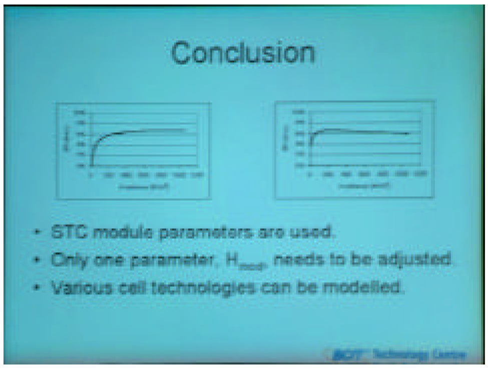
N.M. Pearsall, University of Northumbria, UK; I. Butterss, Building Research Establishment Ltd., Watford, UK



① 住宅用システムのプロジェクト（500 件，750kW 以上）2002 年一杯設置。
② システム設計，施設，システムパフォーマンスの評価，売れ行きの内容が取り上げられた。

(40) 5O5.7 Optimization of Building Integrated Photovoltaic Systems

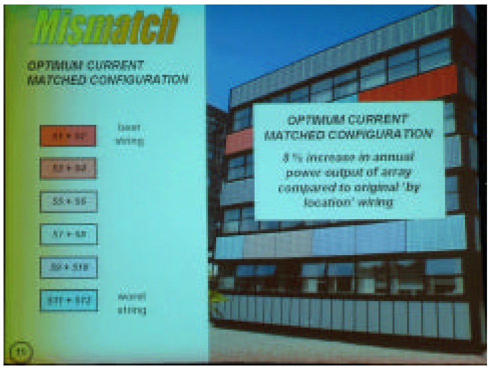
E.W. Smiley and L. Stamenic, British Columbia Institute of Technology, Burnaby BC, Canada



① BIPV システムの出力を求めるためのモデルの開発。
② モデルは理想ダイオードの方程式から生成される。
③ モデルは様々な PV セル技術と全ての日射パターンに適用できる。
④ モデルの実証のために，1kW の系統連系型 PV アレイを使った。

(41) 5O5.8 Post Installation Optimization of a Building Integrated PV System at Southamptom University

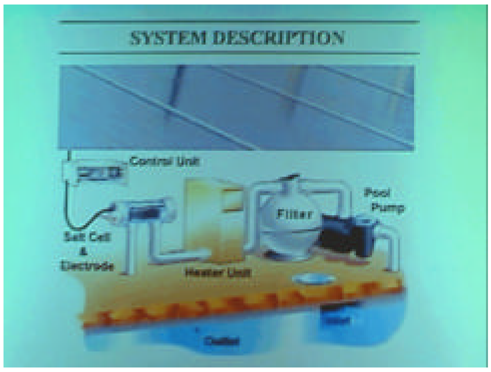
A.S. Bahaj, R.M. Braid, P.A.B. James; Sustainable Energy Research Group, Southampton University, UK



① Southampton 大学（UK）に設置してある BIPV 壁面設置型 PV システムの実測データを基に，ストリングミスマッチに関する研究（特に低い日射量）。
② システムの 24 ストリングの最適化により，（アレイ・ストリングとインバータの組み合わせ）システム効率に 8%の増加。

(42) 5O5.9 Application of PV Electro-chlorination Process

Queensland Univ of Technology, Kouzam



① PV システムの DC 出力を利用し，プールの塩素処理システムの開発。
② そういったシステムは実際に運転しており，その応用の評価の発表だった。

6.4 ポスターセッション

(1) 5P1.1 Monitoring Current Voltage Characteristics of Photovoltaic Modules

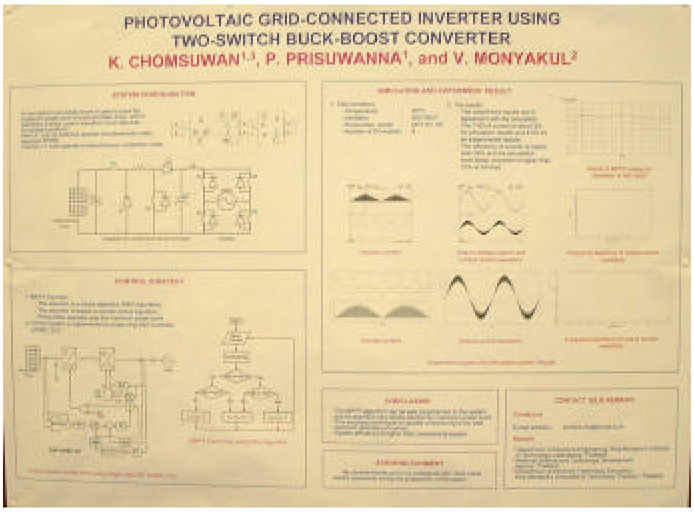
E.E. van Dyk, A.R. Gxasheka, and E.L. Meyer, University of Port Elizabeth, Port Elizabeth, South Africa

① I-V カーブのモニタリングの研究。
② モジュールの I-V カーブ，モジュール温度，外気温がモニターされており，モジュール性能や劣化，故障を分析できる。

(2) 5P1.5 Photovoltaic Grid-Connected Inverter Using Two Switch Buck-Boost Converter

K. Chomsuwan, King Mongkut University of Technology Thonburi; P. Prisuwanna, King Mongkut Institute of Technology Ladkrabang, Bangkok, Thailand; and V. Monyakul, National Science and Technology Development Agency, Thailand

① MPPT とインバータ技術における系統連系インバータの効率向上。
② Two-stage inverter は制御が容易だが，効率が低下する。
③ Single-stage inverter は，効率は高いが制御が複雑。
④ Two-switch Buck-boost converter を用いた Two-stage inverter を提案。
⑤ 提案したシステムは従来の Two-stage システムより効率が高く，Single-stage システムより制御が容易。
⑥ Single-chip DSP を用いている。



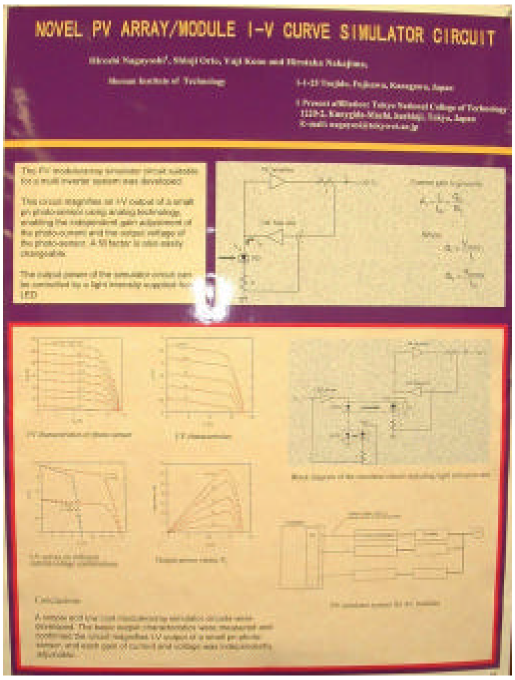
(3) 5P1.6 A Novel Two-Mode MPPT Control Algorithm Based on Comparative Study of Existing Algorithms

G. J. Yu, Y. S. Jung, K. H. Kim, Korea Institute of Energy Research, Taejon, KoreaJ. Y. Choi, Kwangwoon Univ., Seoul, Korea

① 日射が標準の 30%以下の時は Constant Voltage 法, 30%以上の時は Increment Conductance 法を用いる。
② 実験の結果，Two-mode MPPT Control は 30%以下の日射の時，優秀な結果を示した。

(4) 5P1.7 Novel PV Array/Module I-V Curve Simulator Circuit

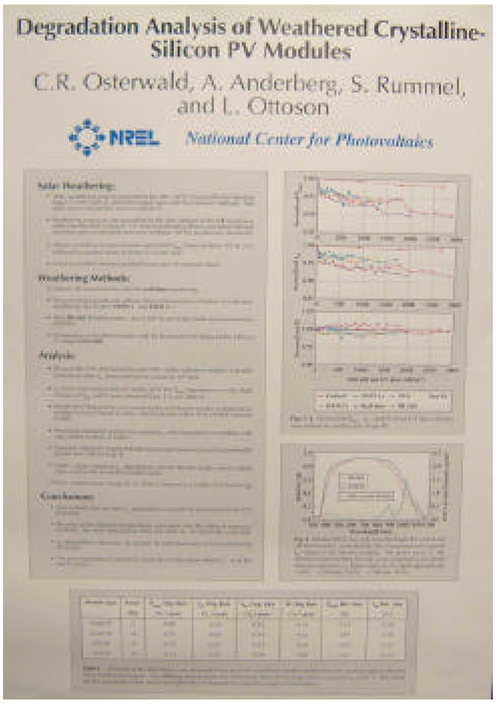
H. Nagayoshi, S. Orio, Y. Kono, H. Nakajima, Shonan Institute of Technology, Kanagawa, Japan



① AC モジュールやストリングインバータを評価するための, 簡易な I-V カーブシミュレータの開発。
② LED の出力を増幅して出力する。

(5) 5P1.9 Degradation Analysis of Weathered Crystalline-Silicon PV Modules

C.R. Osterwald, T. J. McMahon, NREL, Golden, CO



① 結晶シリコン PV モジュールの実時間暴露と加速暴露時の劣化分析。
② 最近 5 年では，モジュール最大電力の減少と総 UV 暴露量の間におよそ線形相関が見られる。
③ I-V 特性の分析では，損失は主に短絡電流の減少によるものである。

(6) 5P1.10 New Barrier Coating Materials for PV Module Backsheets

G. D. Barber, G. J. Jorgensen, K. Terwilliger, T. J. McMahon, NREL, Golden, CO

(4) PV モジュールのバックシートとして PET フィルムが用いられてきた。
(5) これらの薄膜は UV 暴露後にも WVTR(Water Vapor Transimission Rate)は低く，優秀な粘着性を有している。
(6) WVTR と粘着性が他のバックシート材料より優れていることが示された。

(7) 5P1.11 The Development of a Scaled Down Simulator for Distribution Grids and Its Application for Verifying Interference Behavior Among a Number of Module Integrated Converters (MIC)

Y. Noda, T. Mizuno, H. Koizumi, K. Nagasaka, and K. Kurokawa, Tokyo University of Agriculture and Technology, Tokyo, Japan

① 縮小模擬配電線の設計と欧州製 AC モジュールインバータの単独運転試験。
② 複数台連系時の負荷平衡時，単独運転の継続を確認。

(8) 5P1.12 Applications and Field Tests of Bifacial Solar Modules

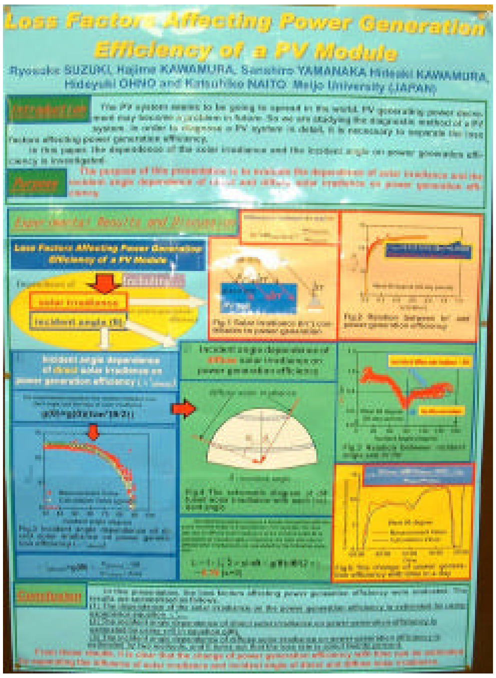
T. Johge, Y. Eguchi, I. Araki, and T. Uematsu, Hitachi, Ltd., Japan; and K. Matsukuma, Sojo Univ., Kumamoto, Japan

① 両面太陽電池モジュールの垂直設置についての研究。
② 両面セルは表面 14.5%，裏面 10.5%の効率。
③ 一日と年間発電電力のシミュレーションを行った。
④ 両面セルの垂直設置の場合，片面セルの場合より年間発電電力量で方角に関わらず 1.4 倍になった。
⑤ フェンス設置システムや防音壁システムなど多くの適用が実証されている。

(9) 5P1.14 Loss Factors Affecting Power Generation Efficiency of a PV Module

R. Suzuki, H. Kawamura, S. Yamanaka, H. Kawamura, H. Ohno, K. Naito, Meijo University, Nagoya-city, Japan

① PV システム診断のためのロスファクターの分離。
② 傾斜角と方位角それぞれの PV モジュールの日射と入射角の影響を調査。
③ 発電効率の時間的変化が推定可能となった。



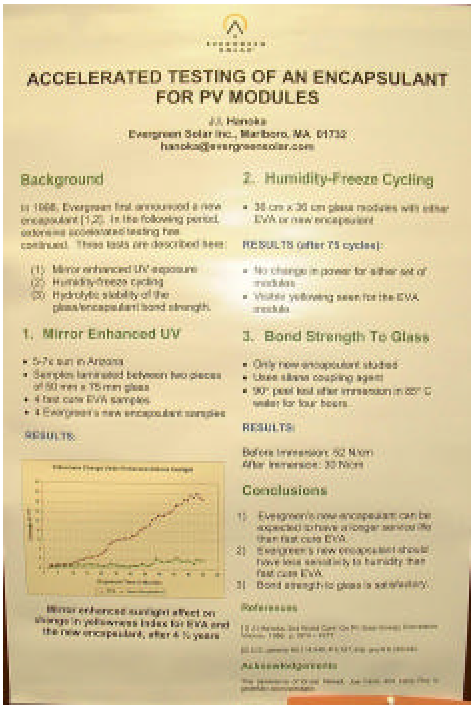
(10) 5P1.15 The Economics of Solar Powered Refrigeration Transport Applications

A.S. Bahaj and P.A.B. James, Sustainable Energy Research Group, University of Southampton, Southampton, UK

① PV システムの冷蔵・冷凍への適用。
② PV チルド配達の経済性評価が開始されディーゼル冷蔵システムとの比較がなされた。
③ PV 冷蔵トレーラーのペイバックタイムは 8 年間である。

(11) 5P1.16 Accelerated Testing of an Encapsulant For PV Modules

J. I. Hanoka, Evergreen Solar, Inc., Marlboro, MA



① 新しい PV モジュール封入材料の開発。
② 紫外線や水蒸気に対して，長期の安定性を持つ。
③ 5 倍集光試験では，EVA に対して，黄色変化では 4 年上回った。

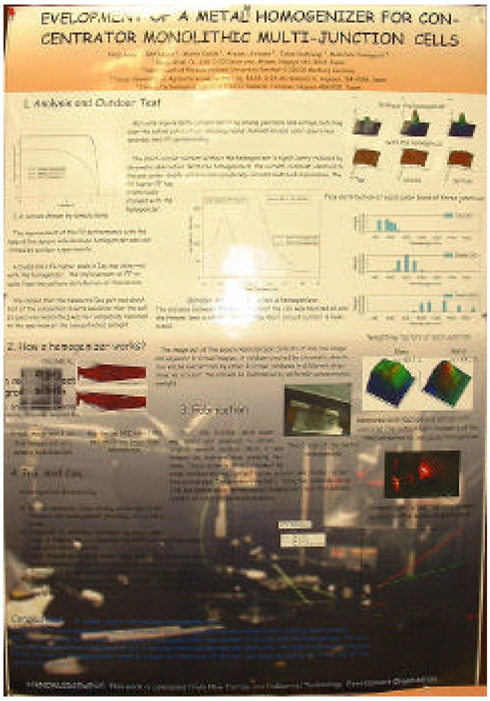
(12) 5P2.1 A Simple Passive Cooling Structure and Its Heat Analysis for 500X Concentrator PV Module

K. Araki, H. Uozumi, Daido Steel Co., Ltd., Nagoya, Japan; M. Yamaguchi, Toyota Technological Institute, Nagoya, Japan

① シンプルかつ効果的な集光用の熱拡散構造を提案
② 屋外実験においてセル温度は 500 倍の集光倍率においても 18℃しか上昇せず，400 倍の非結像角形フレネルレンズにおいても 21℃のみの上昇であった。

(13) 5P2.2 Development of a Metal Homogenizer for Concentrator Monolithic MJ-Cells

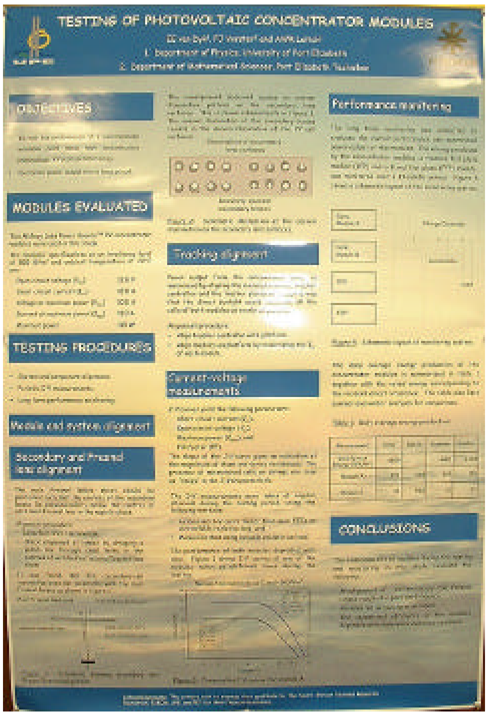
K. Araki, M. Kondo, and T. Kashiwagi, Daido Steel Co., Ltd., Nagoya, JapanR. Leutz, and A. Akisawa, Tokyo University of Agriculture and Technology, BASE, Japan; M. Yamaguchi, Toyota Technological Institute, Nagoya, Japan



① シンプルな角形万華鏡型均質器を開発した。
② 光線の追跡とセルのシミュレーションによると，均質化により短絡電流は 25%の上昇が見込める。屋外即手では 14%の上昇が見られた。この差はセルが集光のスペクトラムに完全にマッチしていないと考えられる。
③ 高反射率のフッ素コートをした銀製プレートを用いたステンレス製の万華鏡を組み立てた
④ この反射率は 6 ヶ月経った後でも保護コートを用いずに 93%の効率を保持した。
⑤ この均質器はセルの総使用量を減らし，集光モジュールのコストを下げる。

(14) 5P2.3 Testing of Photovoltaic Concentrator Modules

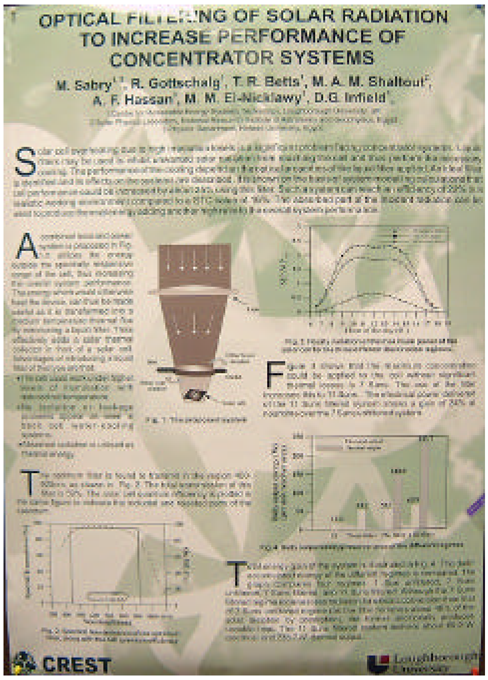
E.E. van Dyk, and A.W.R. Leitch, University of Port Elizabeth, South Africa; F.J. Vorster, Port Elizabeth Technikon, South Africa



① １点集中型集光システムの評価。
② 照準のミスはパフォーマンスや出力の劣化に繋がる。

(15) 5P2.6 Optical Filtering of Solar Radiation to Increase Performance of Concentrator Systems

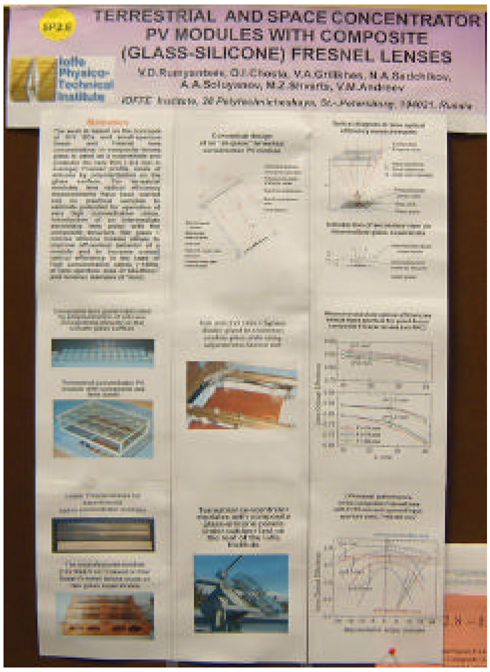
M. Sabry, and M.A.M. Shaltout, Solar Physics Laboratory, National Research Institute of Astronomy and Geophysics, Egypt; A.F. Hassan, and M.M. El-Nicklawy, Helwan Univ., Egypt; R. Gottschalg, T.R. Betts, and D.G. Infield, Centre for Renewable Energy Systems Technology, Loughborough University, UK



① フィルタを用いた集光システム。
② 液体フィルタを用いた集光システムはセル温度を下げるのに有効である。
③ 最適とされたフィルタは 450-920nm の波長を最大限に通し，セルの冷却，スペクトルのマッチングから 30%程度の効率の上昇すると試算された。

(16) 5P2.8 Terrestrial and Space Concentrator PV Modules with Composite (Glass-Silicone) Fresnel Lenses

V.D. Rumyantsev, V.A. Grilikhes, N.A. Sadchikov, M.Z. Shvarts, V.M. Andreev, Ioffe-Physico-Technical Institute, St. Petersburg, Russia; O.I. Chosta, A.A. Soluyanov, Scientific-Production Association "SOLEN", St. Petersburg, Russia



① ガラスとシリコンの複合フレネルレンズを用いた宇宙用，陸上用集光 PV システム。
② 小口径，線形，１点集中型のフレネルレンズを実証した。
③ 陸用では高集光型の能力が実用的と算出された。

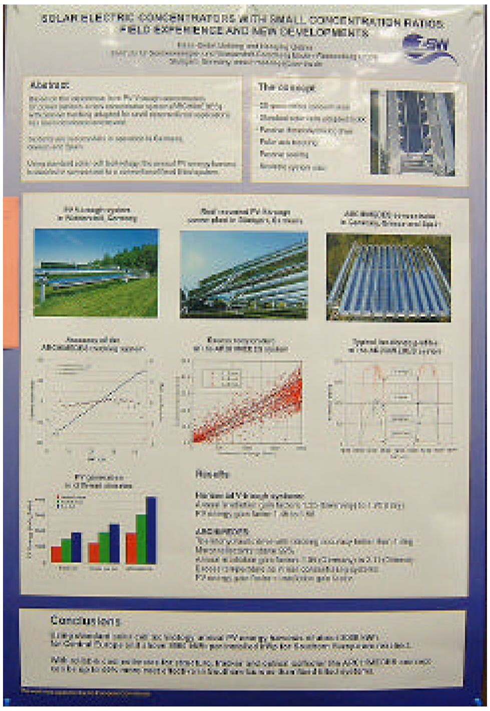
(17) 5P2.10 Investigation on the I-V Characteristics of a High Concentration, Photovoltaic Array

F.J. Vorster, Port Elizabeth Technikon, South Africa; E.E. van Dyk, and A.W.R. Leitch, University of Port Elizabeth, South Africa

① 高集光 PV アレイの I-V 特性の研究。
② I-V 特性は PV 集光型モジュールのパフォーマンス上のミスマッチの影響を詳細に調べる重要な手段である。
③ モジュールの I-V カーブの中にステップが表れると言うことはモジュール中のストリング，もしくはセルに逆にバイアスがかかっていることを示す。
④ これらのステップの位置は集光モジュールによる最大電力を取り出すのに有効である。

(18) 5P2.11 Solar Electric Concentrators with Small Concentration Ratios: Field Experience and New Developments

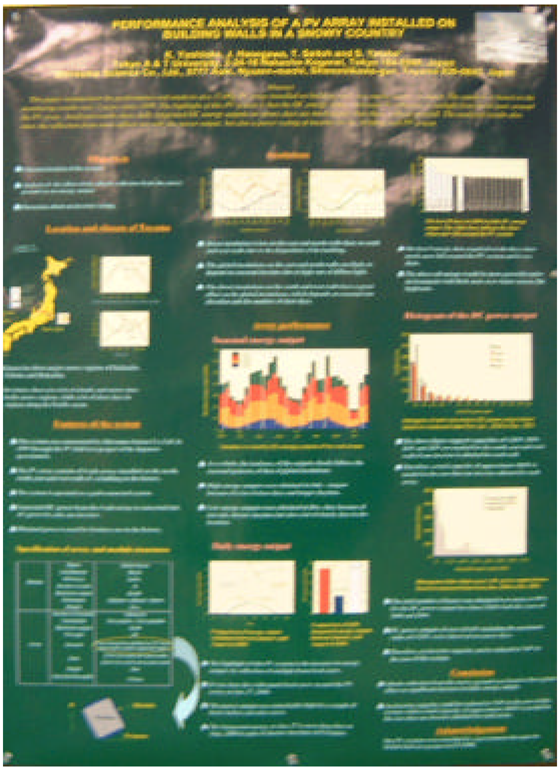
H-D. Mohring, and H. Gabler, . Zentrum fuer Sonnenenergie und Wasserstoff-Forschung, Baaden-Wuerttemberg (ZSW), Stuttgart, Germany



① 2 倍の低集光システム（ARCHIMEDES）の屋外試験と新開発について。
② このシステムは水ポンプ用にデザインされ，ドイツにて運営，テストされている。
③ 中央ヨーロッパにおいては年間 2000kWh/kW, 南ヨーロッパでは年間 3000kWh/kW に達し，成功を修めている。

(19) 5P3.1 Performance Analysis of a PV Array Installed on Building Walls in a Snowy Country

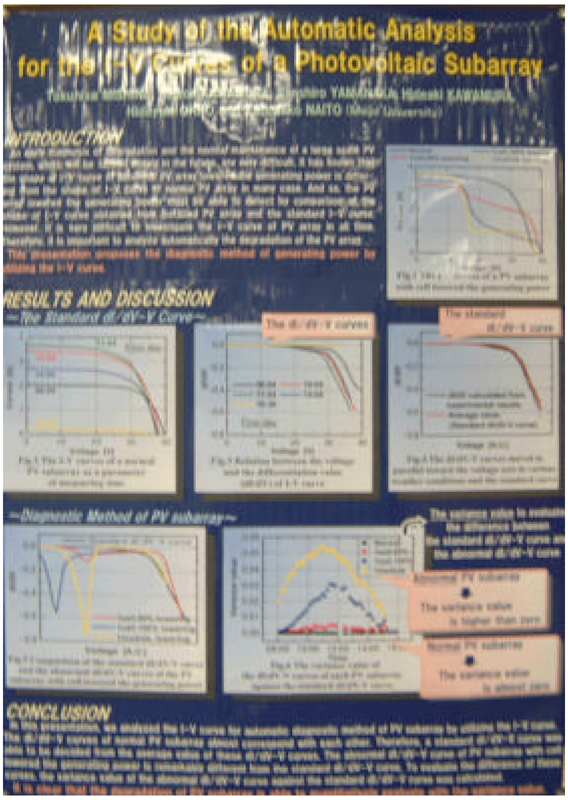
K. Yoshioka, J. Hasagawa, T. Saitoh, Tokyo A&T Univ., Tokyo, Japan; S. Yatabe, Shirouma Science Co., Ltd., Toyama, Japan



① 2 年間の実測データを基に，雪国に設置してある 12kW 壁面設置型 PV システムのパフォーマンスの解析。
② 雪の反射日射量の影響で，システム出力の増加及びインバータ定格の最適化といった内容。

(20) 5P3.4 A Study of the Automatic Analysis for the I-V Characteristics of a Photovoltaic Subarray

T. Mishina, H. Kawamura, S. Yamanaka, H. Kawamura, H. Ohno, K. Naito, Meijo Univ., Nagoya, Japan

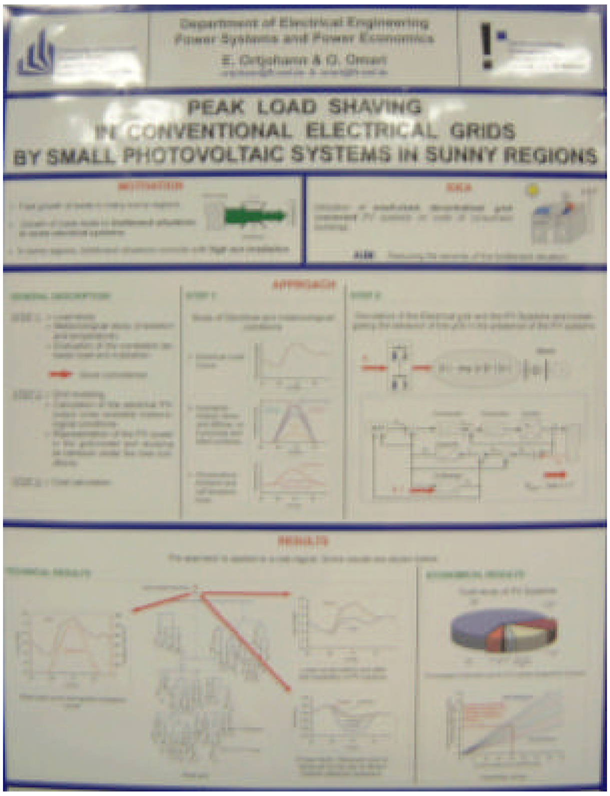


① PV システムアレイの発電特性の性能低下を求める目標として，サブアレイの I-V 特性の自動的な解析に関する研究である。

② 標準的な I-V 特性をもつアレイを基準にし，歪んだ I-V 特性をもつサブアレイの自動的な検出方法の検討

(21) 5P3.5 Peak Load Shaving in Conventional Electrical Grids by Small Photovoltaic Systems in Sunny Region

E. Ortjohann, and O. Omari, University Paderborn/Abteilung Soest, Germany



① 日当たりの良い地域における昼のエネルギー消費のピークをまかなうための分散型系統連系システムの検討。

② そういったシステムの導入に関し，コスト分析，可能性の検討。

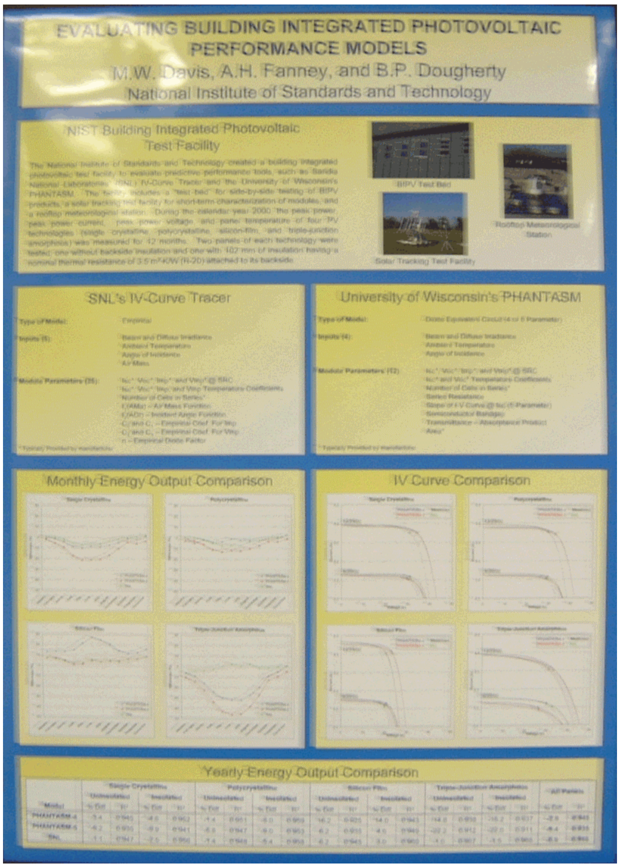
(22) 5P3.6 PV System Integrated Evaluation Software

P.S. Pimentel, T. Oozeki, T. Tomori, K. Kurokawa, Tokyo University of Agriculture and Technology, Tokyo, Japan; H. Matsukawa, Resources Total system Co., Ltd., Tokyo, Japan

① 太陽光発電システムの統合評価ソフトウエアの概要。
② ソフトウエアは基本設計ツール，日陰解析ツール，アレイシミュレーションツール，SV 法の統合でされる。
③ ソフトウエアの実演を行った。

(23) 5P3.7 Evaluating Building Integrated Photovoltaic Performance Models

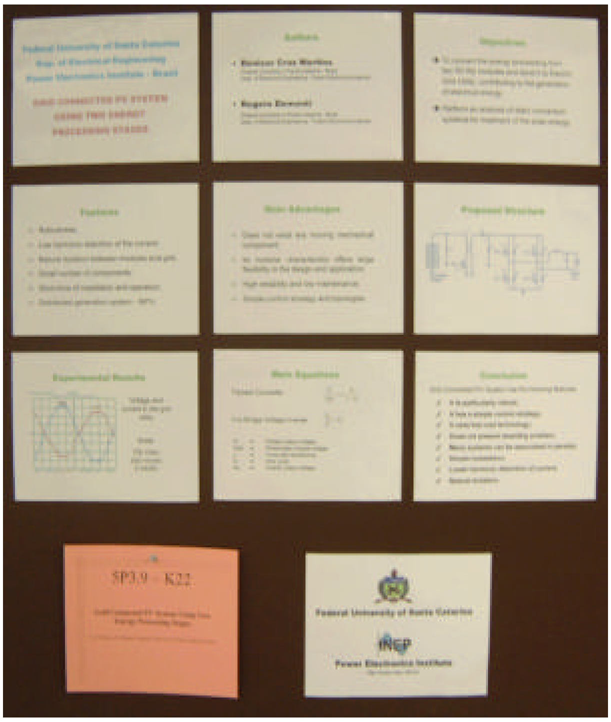
M.W. Davis, A.H. Fanney, and B.P. Dougherty, National Institute of Standards and Technology, Gaithersburg, MD



① 2つのBIPVシステムパフォーマンス予測ソフトウエア（Sandia National LaboratoriesのIV Curve TracerとSolar Energy Laboratory‐Univ.of WinscosinのPHANTASM）からの予測の評価。
② 評価をするために，様々なセル技術の実測データが使われた。

(24) 5P3.9 Grid Connected PV System Using Two Energy Processing Stages

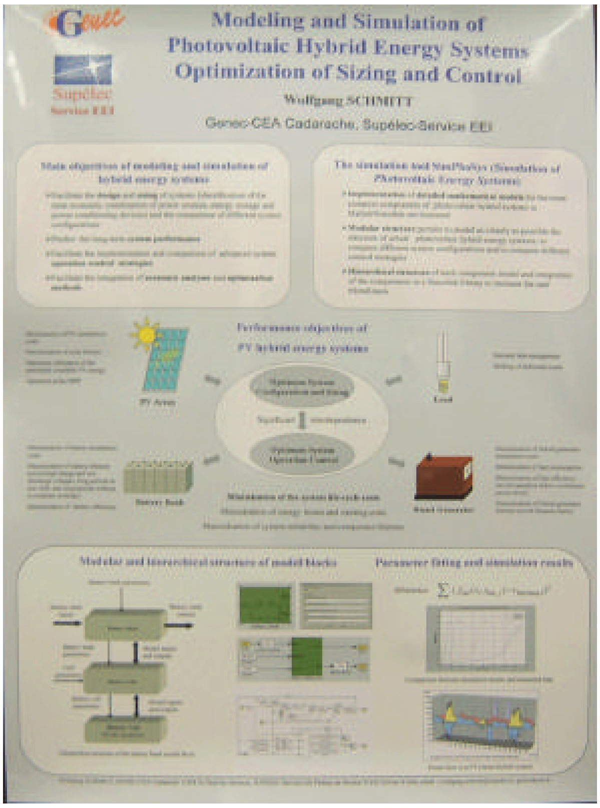
D.D. Martins and R. Demonti; Federal University of Santa Catarina, Brazil



① 2段階で構成される系統連系型システム（Flyback コンバータ & Full-bridge voltage インバータ）の設計手順と試験結果。

(25) 5P3.11 Modeling and Simulation of Photovoltaic Hybrid Energy Systems-Optimization of Sizing and Control

W. Schmitt, Ecole Superieure d'Electricite Service EEI, Yvette, France

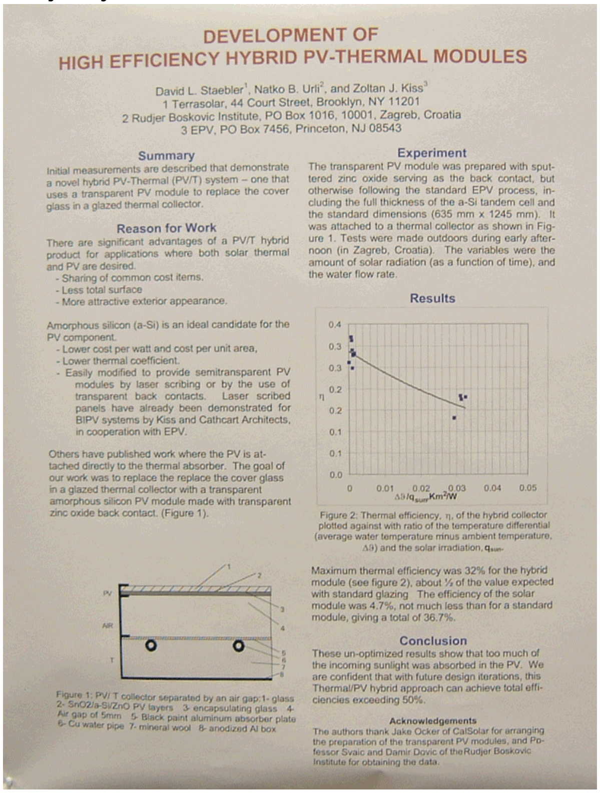


① SimPhoSys というシミュレーション・ツールについての研究。
② ツールはハイブリッドシステム（PV とその他のエネルギー資源）のサイジングとシミュレーションが可能である。
③ 内容的に，主に長期間のシミュレーション速度についての検討。

(26) 5P3.13 Development of High Efficiency Hybrid PV-Thermal Modules

D.L. Staebler, Terrasolar, Brooklyn, NY; N.B. Urli, Rudjer Boskovic Institute, Coatia; Z.J. Kiss, Princeton, NJ

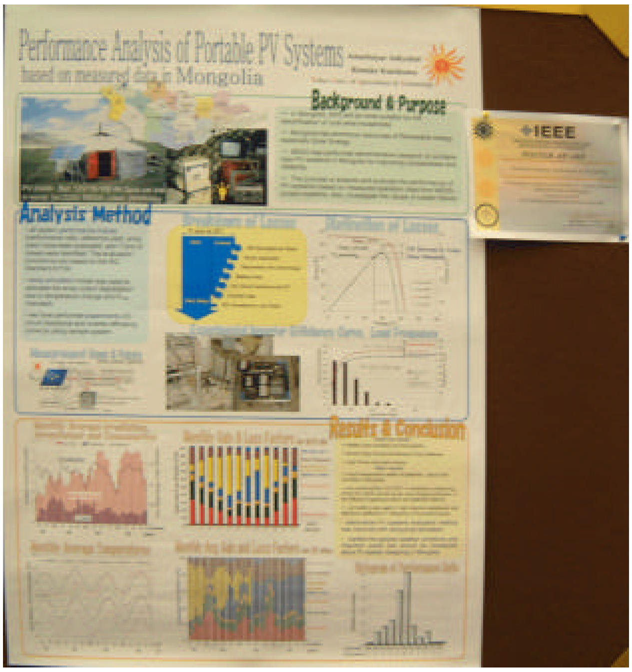
① ハイブリッドシステム（PV＋Thermal モジュール）の開発。
② いろいろな技術の組み合わせの詳細な評価が載っている。



(27) 5P3.15 Performance Analysis of Portable PV Systems Based on Measured Data in Mongolia

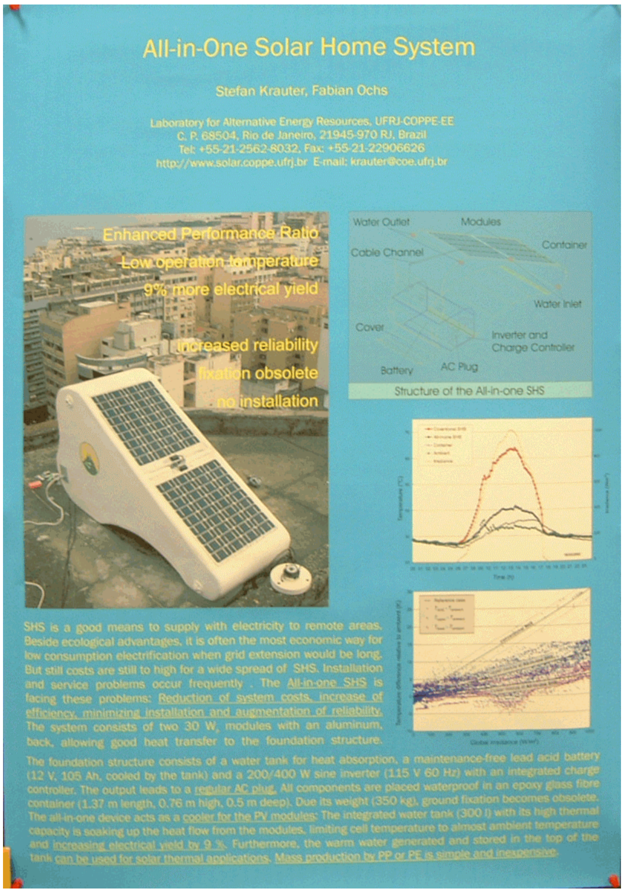
A. Adiyabat, K. Kurokawa, Tokyo University of Agriculture and Technology, Tokyo, Japan

① モンゴルにおける独立型 PV システムのパフォーマンス解析。
② 4 年間におけるモンゴルの独立型 PV システムの実測データ（NEDO）を利用して，サンプルシステムを基に，システム損失の解明，バッテリ結果の検討。



(28) 5P3.16 All-In-One Solar Home System

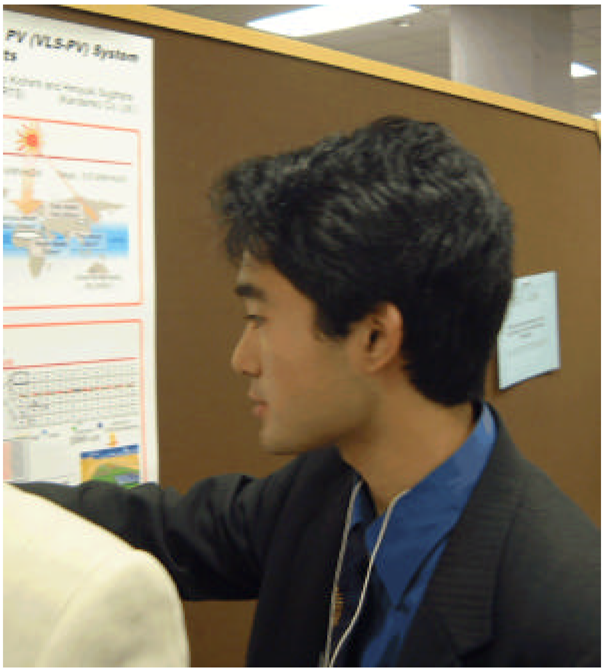
S. Krauter, F. Ochs, Laboratorio Fotovoltaico, Rio de Janeiro, Brazil



① 農村地域で使うための“オール・イン・ワン”ソラーホームシステム（SHS）の開発についての研究。
② パネルの基礎として，水の入ったタンクを使うことにより，セル温度の減少（温水の利用）。
③ システムのコスト分析。

(29) 5P3.17 A Cost Analysis of Very Large Scale PV (VLS-PV) Systems on the World Deserts

K. Kurokawa, M. Ito, Tokyo University of Agriculture and Technology, Tokyo, Japan; K. Kato, New Energy and Industrial Technology Development Organization, Japan; K. Komoto, Fuji Research Institute Corp., Japan; T. Kichimi, Resource Total System Co., Ltd., Japan; H. Sugihara, Kandenko Co., Ltd.



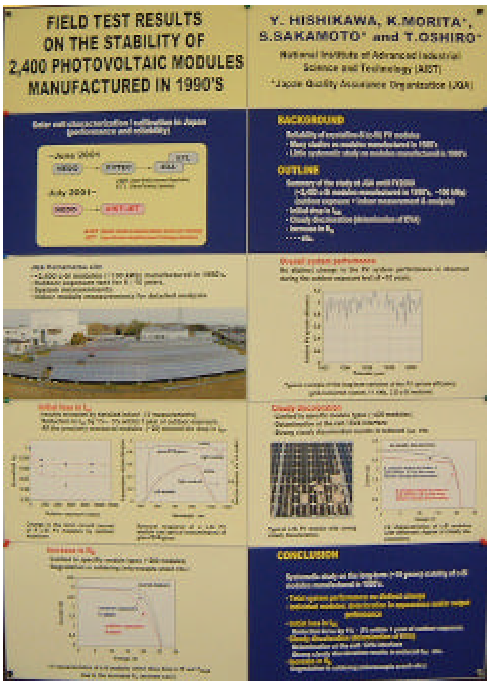
① 砂漠に設置した大型太陽光発電システムのコスト分析に関する研究である。
② 100MW 規模の（VLS-PV）の LCC（Life-Cycle Cost）に基づいた解析結果。

(30) 5P4.1 Application of Photovoltaic Electro-Chlorination Process
K. Khouzam, Queensland University of Technology, Brisbane, Australia

① PV を用いたプールの塩素浄化システムのプロトタイプシステムを 6 箇所に構築した。（世界初）
② 12 ヶ月に渡って，日射量，温度，電圧，電流，塩素レベル，pH，水温，水質（酸素濃度）とプールの使用頻度を計測した。
③ このプロセスは技術的に環境的に利益があり，電気料金も削減できる。PV を用いたプールへの塩素半自動投入は効果的な方法である。

(31) 5P4.8 Field Test Results on the Stability of 2,400 Photovoltaic Modules Manufactured in 1990
Y. Hishikawa, National Institute of Advanced Industrial Science and Technology, Ibaraki, Japan; K. Morita, Japan Electrical Safety & Environment Technology Laboratories, Tokyo, Japan; T. Oshiro, Japan Quality Assurance Organization, Shizuoka, Japan

① JQA が行った，1990 年に製造されたの 2400 枚のモジュールのフィールドテストの結果。
② 全てのモジュールに短絡電流の初期劣化が見られ，いくつかのモジュールはセルや EVA のくもり，色の変化，剥離が見られた。
③ しかし，全てのシステムにおいて，はっきりとした変化を 10 年間のテストでは見られなかった。
④ 20-30 年は信頼性が保てると評価が出来る。



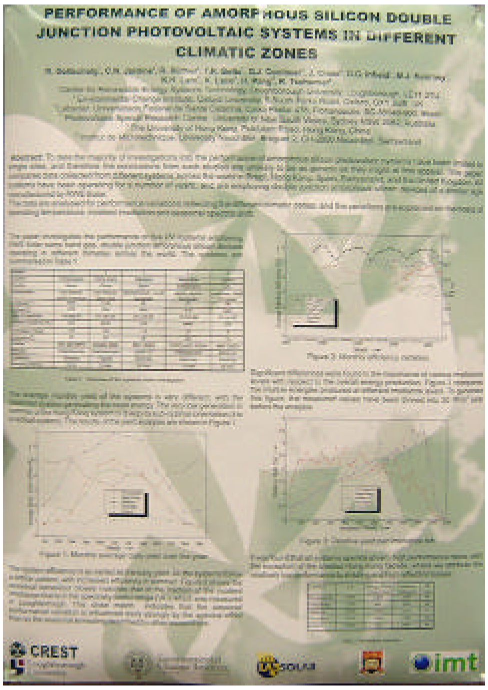
(32) 5P4.9 First Year Performance for Roof-mounted, 45-kW PV Array on Oberlin College's Adams Joseph Lewis Center
J.H. Scofield, Oberlin College, OH

① BP-Solar 社製結晶系モジュール 45kW をアメリカ Adam Joseph Lewis Center に 2000 年 1 月に設置。
② 初年度には 59000kWh の発電量があった。
③ 夜間トランスロスは 4300kWh と推定された。
④ 結晶モジュールの製造エネルギーを考慮し，EPT は 5-6 年と推定した。

(33) 5P4.10 The Performance of Fully Monitored, Double-Junction a-Si Grid-Connected BIPV System after Four Years of Continuous Operation in Brazil
R. Ruther1, 2, M.M. Dacoregio2, and A.A. Montenegro2, 1LABEEE, Brazil, 2LABSOLAR, Florianopolis, Brazil
① ブラジルにおける最初の系統連携アモルファス建材一体型システムの４年間のシステム効率，温度，発電量等のモニター結果。
② 平均システム効率は AC で 83%，DC で 91%である。
③ アモルファスシリコンを選んだことは，温暖な気候では良い選択であると結果が示している。

(34) 5P4.11 Performance of Amorphous Silicon Double Junction Photovoltaic Systems in Different Climatic Zones

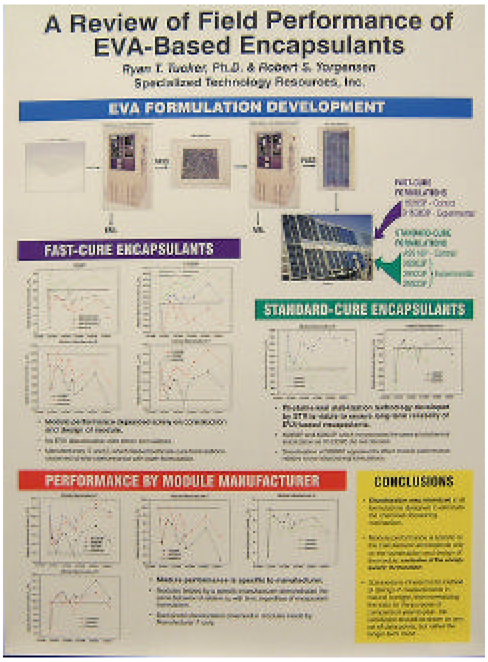
R. Gottschalg, T.R. Betts, D.G. Infield, and M..J. Kearney, Centre for Renewable Energy Systems Technology (CREST), Loughborough, UK; C.N. Jardine, G.J. Conibeer and K. Lane, Environmental Change Institute, University of Oxford, Oxford, UK; J. Close and K.H. Lam, The University of Hong Kong, China; R. Ruther, LABSOLAR, Florianopolis, Brazil; R. Tscharner, Institut de Microtechnique, Neuchatel, France



① 異なった気候（ブラジル，香港，スペイン，スイス，イギリス）におけるアモルファス PV システムのパフォーマンス評価。
② 高温，高日射量であったが，アモルファスシリコンシステムは高いパフォーマンスを示した。

(35) 5P4.12 A Review of Field Performance of EVA-based Encapsulants

R.T. Tucker, R.S. Yorgensen, Specialized Technology Resources, Enfield, CT



① EVA の変色を化学的な変色のメカニズムを取り除くことで最小限にとどめた。
② モジュールのパフォーマンスは製造工程固有であり，モジュールの設置，デザインにのみ変化がある。

(36) 5P4.13 Solar Schools -Experiences with Different Utilities

J. Hoffner, S. Wiese, J. Pichumani, Conservation Services Group, Austin, TX

① 二つの Solar School Programs についての発表。一つは公共機関出資のプログラム，もう一つは州が出資したプログラムである。
② 両者は系統連携され，発電し，生徒への太陽光や再生可能エネルギーの教育の為になる。
③ ウェブサイトにおいてそれぞれの学校の過去 3 日間の出力，日射，風速，温度が表示され，インターネットユーザーはどの学校からもダウンロードできる。

(37) 5P4.14 Recent Application and Performance of Large, Grid-Connected Commercial PV Systems

G. Ball, PowerLight Corp., Berkeley, CA; R.M. Hudson, M.R. Behnke, Xantrex Technologies Inc., Livermore, CA

① Power Light 社の大型商業用系統連携 PV システムの最近のシステムとパフォーマンス（宣伝)。

(38) 5P4.15 Satellite Monitoring of Remote PV-Systems

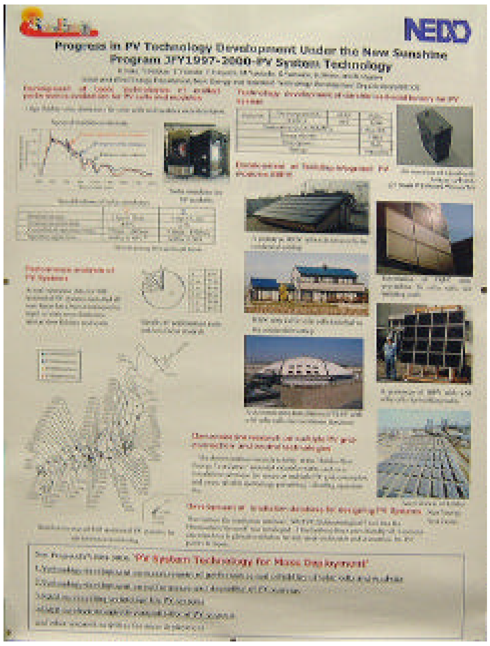
S. Kraufer, F. Ochs, T. Depping, Laboratorio Fotovoltaico, UFRJ-COPPE-EERio de Janeiro, Brazil

① ブラジルにおける衛星を用いたデータ収集システム（ARGOS)。
② 15 分毎にデータを転送する。コストは 20 年で 2350€と従来のデータロガーシステムと比べて 10000€以上のコストダウンである。
③ 測定データの電話やラジオによる通信が出来ない地域等インフラが整備されていない地域においてこのシステムは有効である。

(39) 5P4.17 Progress in PV Technology Development under the New Sunshine Program JFY 1997-2000 ・PV System Technology

K. Kato, Y. Nobue, T. Yokoda, F. Hayashi, M. Yamada, K. Yamada, K. Shino, K. Ogawa, Solar and Wind Energy Department, NEDO, Tokyo, Japan

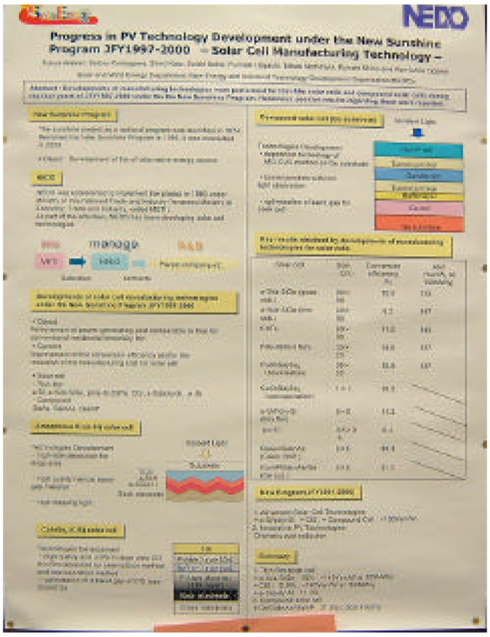
① 1997-2000 年度のニューサンシャイン計画における太陽光発電技術の進捗。
② 様々な R&D が行われた。パフォーマンスの測定技術の開発，セル，モジュールの長期信頼性の評価，PV システム性能の分析，PV システム設計への日射データベースの構築，BIPV の開発，系統連携システム，コントロール技術の研究，実証などが挙げられる。



(40) 5P4.18 Progress in PV Technology Development under the New Sunshine Program JFY 1997 ・2000 ・Solar Cell Manufacturing Technology

F. Aratami, S. Kuriyagawa, S. Kato, S. Sakai, F. Hayashi, T. Nishimura, K. Shino, K. Ogawa,
Solar and Wind Energy Department, NEDO, Tokyo, Japan

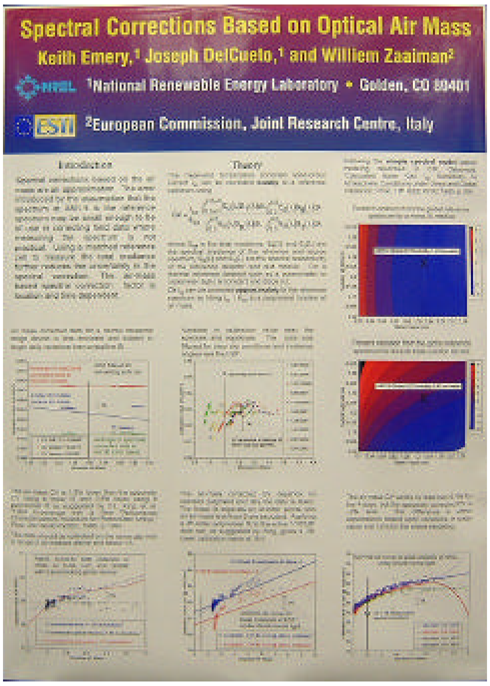
① ニューサンシャイン計画における太陽電池セル製造技術開発の進捗。
② アモルファスシリコンセル，CdTe セル，薄膜多結晶シリコンセル，CIS セル，ハイブリッドセルの開発ついて。



(41) 5P4.20 Spectral Corrections Based on Optical Air Mass

K. Emery, NREL, Golden, CO, and W. Zaaiman, European Commission Joint Reseach Centre, Italy

① 大気路程によるスペクトル吸収について。
② 自然光の元でエアマスによるデータのスペクトル吸収を測定し，近似を行った。



6.5 表彰

(1) Solar Energy Medal 賞講演=Barnet

(2) IEEE フェロー：斎藤忠教授（東京農工大学）

(3) ポスター賞(システム分野)：アマル，黒川（東京農工大学）

7．記録（講演スライド・ポスター）

7.1 プレナリ

PL1_2_Aratani, NEDO: JP PV technology
PL1_3_d'Estaintot, EC: EU PV R&D
PL1_4_Basore, Pacific Solar: Thin-filn c-Si pilot production
PL1_5_King, Spectrolab: Bandgap controlled cell structure
PL1_6_Bonn, SNL: Next generation inverters

PL3_1_Kazmerski: US PV R&D
PL3_2_Sastry: National Program India
PL3_3_Wagner: National Program Germany
PL3_4_Sinke: National Program Netherlands
PL3_5_Konagai: National Program Japan
PL3_1_Kazmerski=US PV R&D
PL3_2_Sastry=National Program India
PL3_3_Wagner=National Program Germany
PL3_4_Sinke=National Program Netherlands
PL3_5_Konagai=National Program Japan

PL4_3_Ferlato, Pennsylvania State Univ=Thickness evolution 0f Si_H nanostructue
PL4_4_King, SNL=Analysis of factors influencung the annual energy production

7.2 オーラル

1O1_1_Rosenblum, ASE America: PVMaT EFG plasma etch
1O1_2_Eager, BP Solar: Environtally friendly processes
1O1_3_Hanoka, Evergreen: PV MaT
1O1_4_Cudzinovic, SunPower: High efficiency bifacial Si
1O1_5_Kalejs, ASE: EFG_production line
1O1_6_van Kerschaver, IMEC: Screen printed module fabrication
1O1_7_Sims, AstroPower: Silicon on Ceramic

5O2_2_Osterwald_NREL: c-Si Module Degradation
5O2_3_Hudson, Xantrex: 3 Phase Inverters
5O2_4_Pelosi, Muri Solar Energy Software: PC software in inverters
5O2_5_Whitaker, Endecon_PV: inverter certification
5O2_6_Jung, KIER: HF link inverter
5O2_7_Hudson, Xantrex: anti-islanding test for IEEE 929-2000
5O5_1_Diniz, CEMIG=LUZ solar program for rural pre-electrification and lessons from over 100 PV installations
5O5_2_Hanley, SNL=Rural internet connectivity & distant education in Latin America
5O5_3_Solar OV water pumping comes of age in India
5O5_4_Indonesian effort to a better quality of solar home system
5O5_5_Fanney, NIST=Performance BIPV
5O5_6_Pearsall, Northunbia Univ=UK domestic PV systems Filed Trial
5O5_7_Smiley, British Columbia Inst of Techn=Optimization of BIPV
5O5_7_Smiley, British Columbia Inst of Techn=Optimization of BIPV
5O5_8_Bahaj, Univ Susampton=Post installation optimization of BIPV

5O5_9_Kouzam, Queensland Univ of Techn=Application of PV electro-chrolination process

5O5_10_Tra Wiley, Solar Electric Power Corp=Peroformance, cost, operational experience

7.3 ポスター

1P2_7_Schoenecker, ECN, Ribbon growth on substrate
3P1_4_Fraas, JX Crystals=34% mechanically stacked GaInP_GaAs-GaSb circuit
3P2_1_Simburger=PowerSphere concept
5P3_16_Krauter, Lab Fotovoltaico=All-in-one SHS
5P3_19_Hoffner, Conservation Service Gr=A solar utility(green certificate)
5P3_5_Ortjohann, Univ Paderborn=Peak load shaving in grids

7.4 ランプセッション

Rump Session: 2020 Vision for 2020 Industry Challenges

Aurich: Si Feestock
Tucker: Encapsulant
McNelis: System
Fitzgelrald: Training

7.5 表彰

Solar Energy Medal **賞講演**=Barnet

8 所感

9　収集論文

分野別入手論文リスト（Poster Session）

2002年6月4日現在

No.	1P1	1P2	1P3	1P4	2P1	2P2	2P3	3P1	3P2	3P3	4P1	4P2	4P3	5P1	5P2	5P3	5P4
date	21（火）PM	22（水）AM	22（水）PM	23（木）PM	22（水）AM	23（木）PM	21（火）PM	21（火）PM	22（水）PM	22（水）AM	22（水）AM	22（水）PM	23（木）PM	21（火）PM	22（水）PM	23（木）PM	24（金）PM
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13		○				＼							●	●			○
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18			○													＼	○
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○‥‥入手資料（電子ファイル無）、●‥‥入手資料（電子ファイル有り）、△‥‥入手確約済み

＼‥‥Withdrawn（ポスター掲示なし）

空欄‥‥未入手資料

10　全論文リスト
本会議に発表された全ての基調講演・オーラル発表・ポスター発表の論文リストを以下に示す：

Tuesday, May 21, 2002
Morning Session　Regency E　8:00　・　10:00
Plenary Session

Chairs: J. Benner and R. Arya
8:00
Welcome Address
John Benner, NREL Golden, CO; Rajeewa Arya, BP Solar, Toano, VA;Ron Diamond, Spectrolab, Sylmar, CA
8:15
Keynote Address: USA TBD
8:30
Keynote Address: Japan
Present Status of Research and Development of PV Technology in Japan
Ken-ichiro Ogawa, Director General, Solar and Wind Energy Department, New Energy and Industrial Technology Development Organization (NEDO), Tokyo, Japan
8:45
Keynote Address: EU
PV R&D in Europe - Past, Actual and Future European Commission Supportive Actions
Thierry Langlois d'Estaintot, European Commission, Research Directorate General, Improvement of Energy Efficiency Unit, Brussels, Belgium
9:00
Pilot Production of Thin-Film Crystalline Silicon on Glass Modules

Paul Basore, Pacific Solar Pty Limited, Botany, Australia
9:20
High Efficiency Space and Terrestrial Multijunction Solar Cells Through Bandgap Control in Cell Structures
R. R. King, C. M. Fetzer, P.C. Colter, K. M. Edmondson, J. H. Ermer, H. L. Cotal, H. Yoon, A. P. Stavrides, G. Kinsey, D. D. Krut, N. H. Karam, Spectrolab, Inc., Sylmar, CA
9:40
Technical Requirements for a Next Generation PV Inverter

R. H. Bonn, et al., Sandia National Laboratories, Albuquerque, NM

Wednesday, May 22, 2002
Morning Session　Regency E　8:00　・　9:50
Plenary Session

Chairs: C. Wronski and A. Rohatgi
8:00
National Program: Australian Photovoltaic Research and Development

Martin Green, University of New South Wales, Australia
8:15
National Program: Status and Perspectives of the PV R&D Programme in Italy

Francesca Ferrazza, Eurosolare, Rome, Italy
8:30
Polycrystalline Thin Film Photovoltaics: Research, Development and Technologies

H. Ullal, K. Zweibel, and B. von RoedernNational Renewable Energy Laboratory, Golden, CO
8:50
Amorphous Silicon Technology

S. Guha and J. YangUni-Solar, Troy, Michigan
9:10
The Fraunhofer ISE Roadmap for Crystalline Silicon Solar Cell Technology

G. Willeke, Fraunhofer ISE, Germany
9:30
Thin Film and Crystalline Solar Cell Array System Comparisons
D. M. Murphy, M. I. Eskenazi, B. R. Spence, and S. F. White, AEC-Able Engineering, Goleta, CA

Thursday, May 23, 2002
Morning Session　Regency E　8:00　・　9:15
Plenary Session

Chairs: M. Yamaguchi and T. Bruton
8:00
National Program: US PV R&D: Positioning for the Future

L.L. Kazmerski, National Renewable Energy Laboratory, Golden, CO
8:15
National Program: The Photovoltaic Program in India

E.V.R. Sastry, Ministry of Non-Conventional Energy Sources, Govt. of India, India
8:30
National Program: PV Programs in Germany

H. Wagner, Germany
8:45
National Program: Development and implementation of PV in The Netherlands

Wim Sinke, ECN Solar and Wind Energy, The Netherlands
9:00
National Program: Thin Film Solar Cells Program in Japan - Achievements and Challenges

M. Konagai, Tokyo Institute of Technology, Tokyo, Japan

Friday, May 24, 2002
Morning Session　Regency E　8:00　・　9:20
Plenary Session

Chairs: K. Zweibel and W. Bower
8:00
Solar Decathlon

C. Warner, NREL, Golden, CO
8:20
CIS Manufacturing at the Megawatt Scale

R.D. Wieting, Siemens Solar Industries, Camarillo, CA
8:40
Thickness Evolution of the Microstructural and Optical Properties of Si:H Films in the Amorphous-to-Microcrystalline Phase Transition Region
A.S. Ferlauto, G.M. Ferreira, C.R. Wronski, and R.W. Collins, Materials Research Institute and Center for Thin Film Devices, The Pennsylvania State University, University Park, PA
9:00
Analysis of Factors Influencing the Annual Energy Production of Photovoltaic Systems
D.L. King, W.E. Boyson, and J.A. Kratochvil, Sandia National Laboratories, Albuquerque, NM

Tuesday, May 21, 2002
Oral Session 101 Regency E 10:30　・　12:15
Cell and Module Manufacturing

Chairs: T. Jester and J. Wohlgemuth
10:30
101.1
PVMaT Technology Improvements in the EFG High Volume PV Manufacturing Line
M. D. Rosenblum, B. R. Bathey, J. Cao, A. Gonsiorawski, B. H. Mackintosh, S. B. Southimath, J. M. Doedderlein and J. P. Kalejs, ASE Americas, Inc., Billerica, MA
10:45
101.2
Environmentally Friendly Processes in the Manufacture of Saturn Solar Cells
S. Eager, N. Mason, T. Bruton, and J. Sherborne, BP Solar,

ETC, Sunbury on Thames, UK; and R. Russell, BP Solar Espana S.A., Madrid, Spain
11:00
101.3
PVMat Contributions Towards Evergreen Solar's New Factory

J. I. Hanoka, Evergreen Solar, Marlboro, MA
11:15
101.4
Process Simplications to the Pegasus Solar Cell - SunPower's High-Efficiency Bifacial Silicon Solar Cell

M. J. Cudzinovic, K. R. McIntosh, SunPower Corp., Sunnyvale, CA
11:30
101.5
Advances in High Throughput Wafer and Solar Cell Technology for EFG Ribbon
J. Kalejs and B. Mackintosh, ASE Americas, Inc., Billerica, MA; W. Schmidt and B. Woesten, RWE Solar GmbH, Alzenau, Germany
11:45
101.6
Record High Performance Modules Based On Screen Printed MWT-Solar Cells
E. Van Kerschaver, C. Allebe, S. De Wolf, J. Szlufcik, IMEC vzw, Leuven, Belgium; L. Frisson, Soltech NV, Leuven, Belgium
12:00
101.7
Thin Silicon-on-Ceramic Solar Cells
P. Sims, E. Delle Donne, A. Ingram, R. Jonczyk, J. Yaskoff, J. Rand, and A. Barnett, AstroPower, Inc., Newark, DE

Tuesday, May 21, 2002
Oral Session 102 Regency E 13:30 • 15:15
Thin Silicon

Chairs: M. Green and R. Ahrenkiel
13:30
102.1
Crystalline Thin-film Si Cells From Layer Transfer Using Porous Si (PSI Process)
R. Brendel, K.Feldrapp, D. Scholten, R. Auer, M. Schulz, Bavarian Center of Applied Energy Research (ZAE Bayern), Erlangen, Germany; M. Steinhof, R. Hezel, Institut f • Solarenergieforschung Hameln (ISFH), Emmerthal, Germany
13:45
102.2
Investigation of Barrier Layers on Ceramics For Silicon Thin Film Solar Cells
A. Slaoui, M. Rusu, PHASE-CNRS, Strasbourg FR; R. Torrecillas and E. Alvarez, CIM, Montgat, Spain
14:00
102.3
APIVT rown Silicon Thin Layers and PV Devices
T. H. Wang, T. F. Ciszek, M. R. Page, R. E. Bauer, Q. Wang, and M. D. Landry, NREL, Golden, CO
14:15
102.4
Characterization of Silicon-Film • nbsp; Sheet Material
J. Rand, AstroPower, Newark, DE; G. Rozgonyi, NC State University, NC; and R. Reedy, NREL, Golden, CO
14:30
102.5
Comprehensive Study of the Doping and Injection-Level Dependence of Stoichiometric Plasma Silicon Nitride Passivation for Silicon Solar Cells
M. J. Kerr, A. Cuevos, Centre for Sustainable Energy System, Dept. of Engineering, Australian National University, Canberra, Australia
14:45
102.6
ACE Designs: The Beauty of Rear Contact Solar Cells
A. Sch ecker, D. Eikelboom, P.Manshanden, M. Goris, P. Wyers, Energy Research Centre of the Netherlands, ECN, The Netherlands; S. Roberts, T. Bruton, BP Solar, Sunbury-on-Thames, UK; W. Jooss, K. Faika, A. Kress, R. Kuhn, P. Fath, University of Konstanz, Konstanz, Germany; F. Ferrazza, R.V. Nacci, Eurosolare S.p.A., Nettuno, Italy; E. van Kerschaver, J. Szlufcik, Interuniversitary Microelectronics Center, Leuven, Belgium; O. Leistiko, A. Jorgensen, Technical University of Denmark, Lyngby, Denmark; s.W. Glunz, J. Dicker, D. Kray, J. Solter and S. Schafer, Fraunhofer Institute for Solar Energy Systems, Freiburg, Bermany
15:00
102.7
Thin (70-100 um) Crystalline Silicon Cells for Conformable Modules

D. L. Meier, EBARA Solar, Inc., Belle Vernon, PA

Wednesday, May 22, 2002
Oral Session 103 Regency E 13:30 • 15:15
Contacts and Metallization

Chairs: J. Rand and A. Munzer
13:30
103.1
Novel Back Contact Silicon Solar Cells Designed For Very High Efficiencies and Low-Cost Mass Production

R. Hezel, ISFH, Emmerthal, Germany
13:45
103.2
Investigation of Thin Aluminum Films on The Rear of Monocrystalline Silicon Solar Cells for Back Surface Field Formation

O.N. Hartley, R. Russell, N.B. Mason, T.M. Bruton, BP Solar Sunbury on Thames, UK
14:00
103.3
Process and Technology Development for Back Contact Silicon Solar Cells
W. Jooss, W. Neu, K. Faika, H. Knauss, A. Kress, S. Keller, P. Fath, E. Bucher, University of Konstanz, Konstanz, Germany
14:15
103.4
Pad Printed Front Contacts for c-Si Solar Cells - A Technological and Economical Evaluation

D. M. Huljic, S. Thormann, R. Preu, R. Ludemann, Fraunhofer ISE, Freiburg, Germany
14:30
103.5
Laser Fired Contacts - Transfer of a Simple High Efficiency Process Scheme to Industrial Production

R. Preu, E. Schneiderlochner, A. Grohe, S. W. Glunz, and G. Willeke, Fraunhofer ISE, Freiburg, Germany
14:45
103.6
Progress in Screen Printed Front Side Metallization Schemes for CSiTF Solar Cells

J. Rentsch, D. M. Huljic, S. Reber, R. Ludemann, Fraunhofer ISE, Freiburg, Germany
15:00
103.7
Electronic Transport in MIND Model Solar Cells: Collection Efficiency in the Presence of a-Si/c-Si Heterointerfaces
M. Ley, Z.T. Kuznicki, Laboratoire, PHASE, Strasbourg, France; D. Ballutaud, CNRS/LPSC, Meudon, France

Wednesday, May 22, 2002
Oral Session 104 Regency E 17:50 • 19:35
Surface Texturing and Passivation

Chairs: D. Ruby and G. Willeke
17:50

104.1
Enhanced Near IR Absorption in Random, RIE-Textured Silicon Solar Cells: The Role of Surface Profiles
S.H.Zaidi, Gratings, Inc., Albuquerque, NM; D.Ruby and J.M.Gee, Sandia National Laboratories, Albuquerque, NM; K. Dezetter,University of New Mexico, Albuquerque, NM
18:05
104.2
RIE-Texturing of Industrial Multicrystalline Silicon Solar Cells
D. S. Ruby, Sandia National Laboratories, Albuquerque, NM; S.H. Zaidi, Gratings, Inc., Albuquerque, NM; S. Narayanan, BP Solar; Frederick, MD; B. Bathey, ASE Americas, Billerica, MA; S. Yamanaka, Ebara Solar, Inc., Belle Vernon, PA; R. Balanga, Siemens Solar Industries, Camarillo, CA
18:20
104.3
Optically Enhanced Absorption in Thin Silicon Layers Using Photonic Crystals
J. M. Gee, Sandia National Laboratories, Albuquerque, NM
18:35
104.4
High-Rate (>1nm/s) Plasma Deposited a-SiNx:H Films formc-Si Solar Cell Application
J.Hong, W.M.M. Kessels, F.J.H. van Assche, M.C.M. van de Sanden, Eindhoven University of Technology, The Netherlands; W .M. A. Bik, IDebye Institute, Utrecht University, The Netherlands; H.C. Rieffe, W.J. Soppe, A.W. Weeber, ECN Solar Energy, The Netherlands
18:50
104.5
On Combining Surface and Bulk Passivation of Sinx:H Layer for mc-Si Solar Cells
W. J. Soppe, C. Devilee, S.E.A. Schiermeier, J. H. Bultman, A.W. Weebner, ECN Solar Energy, The Netherlands; J.Hong, W.M.M. Kessels, M.C.M. van de Sanden,Eindhoven University of Technology, The Netherlands; W .M. Arnoldbik, Debye Institute, Utrecht University, The Netherlands
19:05
104.6
Fixed Charge Density in Silicon Nitride Films On Crystalline Silicon Surfaces Under Illumination

S. Dauwe, J. Schmidt, A. Metz, R. Hezel, Institut fur Solarenergieforschung Hameln, Emmerthal, Germany
19:20
104.7
Thin Multicrystalline Silicon Solar Cells with Silicon Nitride Front and Rear Surface Passivation
L. Mittelstadt, A. Metz, R. Hezel, Institut fur Solarenergieforschung Hameln, Emmerthal, Germany

Thursday, May 23, 2002
Oral Session 105
Regency E 9:35 • 11:50
Hydrogenation, Passivation and Gettering
Chairs: M. Symko-Davies and J. Hanoaka
9:35
105.1
Synergy of Phosphorus Gettering and Hydrogenation in Multicrystalline Silicon Wafers and Cells
S. Martinuzzi, F. Warchol and I. Perichaud, University of Marseille, France
9:50
105.2
Thermo-Catalytic Deposition of Silicon Nitride • A NewMethod for Excellent Silicon Surface Passivation
J.D. Moschner, J. Schmidt, R. Hezel, Institut fur Solarenergieforschung Hameln, Emmerthal, Emmerthal, Germany
10:05
105.3
Formation and Annihilation of the Metastable Defect in Boron-Doped Czochralski Silicon
J. Schmidt, K. Bothe, R. Hezel, Instut fur Solarenergieforschung Hameln, Emmerthal, Germany
10:20
105.4
15% Efficient Large Area Screen Printed String Ribbon Solar Cells
G. Hahn, A. Hauser, Universitat Konstanz, Konstanz, Germany; A.M. Gabor, M.C. Cretella, Evergreen Solar, Marlboro, MA
10:35
105.5
Spatially Resolved Lifetimes in EFG and String Ribbon Silicon after Gettering and Hydrogenation Steps
P. Geiger, G. Kragler, G. Hahn, P. Fath, E. Bucher, Universitat Konstanz, Konstanz, Germany
10:50
105.6
Advanced Defect Characterization by Combining Temperature- and Injection-Dependent Lifetime Spectroscopy (TDLS and IDLS)
S. Rein, P. Lichtner, W. Warta, S. Glunz, Fraunhofer ISE, Freiburg, Germany
11:05
105.7
Effective Reduction of the Metastable Defect Concentration in Bopron-Doped Czochralski Silicon for Solar Cells
K. Bothe, J. Schmidt, R. Hezel, Institut fur Solarenergieforschung Hameln, Emmerthal, Germany
11:20
105.8
Correlation of Spatially Resolved Lifetime Measurements with Overall Solar Cell Parameters
J. Isenberg, J. Dicker, S. Riepe, C. Ballif, S. Peters, H. Lautenschlager, R. Schindler, W. Warta, Fraunhofer, ISE, Freiburg, Germany
11:35
105.9
Bulk Passivation in Multicrystalline Silicon Buried Contact Solar Cells
W. Jooss, P. Fath, E. Bucher, Universitat Konstanz, Konstanz, Germany; S. Roberts, T.M. Bruton, BP Solar, Sunbury-on-Thames, UK

Thursday, May 23, 2002
Oral Session 106
Regency E 13:30 • 15:15
Silicon and Module Materials
Chairs: S. Hogan and H. Aulich
13:30
106.1
Solar Grade Silicon from Metallurgical-Grade Silicon via Iodine Chemical Vapor Transport Purification
T.F. Ciszek, T.H. Wang, M.R. Page, R.E. Bauer, and M.D. Landry, NREL, Golden, CO
13:45
106.2
Float-zone and Czochralski Crystal Growth and Diagnostic Solar Cell Evaluation of a New Solar-Grade Feedstock Source
T.F. Ciszek, M.R. Page, T.H. Wang, and J.A. Casey, NREL, Golden, CO
14:00
106.3
Rapid Thermal Processing: A Comprehensive Classification of Silicon Materials
S. Peters, C. Ballif, D. Borchert, Fraunhofer, ISE, Gelsenkirchen, Germany; J.Y. Lee, S.W, Glunz, W. Warta, and G. Willeke, Fraunhofer, ISE, Freiburg, Germany
14:15
106.4
High Efficiency PERT Cells on n-type Silicon Substrates

J. Zhao, A. Wang, M. A. Green, University of New South Wales, Australia
14:30
106.5
H Diffusion for Impurity and Defect Passivation: A Physical Model for Solar Cell Processing

B.L. Sopori, Y. Zhang, R. Reedy, NREL, Golden, CO
14:45
106.6
Improvements in Polycrystalline Silicon PV Module Manufacturing Technology

J.H. Wohlgemuth, S. P. Shea, BP Solar, Frederick, MD
15:00
106.7
Effect of Glass Na Content on Adhesional Strength of PV Modules

N.G. Dhere and N.R. Raravikar, Florida Solar Energy Center, Cocoa, FL

Thursday, May 23, 2002
Oral Session 201
Regency F 9:35 • 11:50
CdTe and CuInSe2 Materials and Processing
Chairs: K. Ramanathan and B. Basol
9:35
201.1
Formation of CdSxTe1-x Alloys and their Correlation to the Properties of CdS/CdTe Thin-Film Solar Cells

R. Dhere, X. Wu, D. Albin, C. Perkins, H. Moutinho, T. Gessert, NREL, Golden, CO
9:50
201.2
Cadmium Zinc Telluride Films for Wide Band Gap Solar Cells

B.E. McCandless, Institute of Energy Conversion, University of Delaware, Newark, DE
10:05
201.3
Visible and X-Ray Spectroscopy Studies of Defects in CdTe
A. Gupta, A.D. Compaan, K. Price, A. Vasko, K. Hinko, X. Liu, M. Fritts, University of Toledo, Toledo, OH; N. Leyarovska, Illinois Institute of Technology, Chicago, IL and J. Terry, University of Notre Dame, South Bend, IN
10:20
201.4
Electronic Structure and Doping of P-Type Transparent Conducting Oxides

S.-H.. Wei, X. Nie, S.B. Zhang, NREL, Golden, CO
10:35
201.5
Defects in II-VI Photovoltaic Materials and the Origin of Failure to Dope Them

A. Zunger, NREL, Golden, CO
10:50
201.6
Transport Mechanism of Solar Cell Grade Polycrystalline CuGaSe2 Thin Films
S. Schuler, S. Nishiwaki, N. Rega, S. Brehme, S. Siebentritt, M. Ch.Lux-Steiner, Hahn-Meitner-Institut, Berlin, Germany
11:05
201.7
Investigation of Cu(In,Ga)Se2 Thin Films Used in High Efficiency Devices
R. Noufi, J. Yan, J. Abu-Shama, K. Jones, M. Al-Jassim, B. Keyes, J. Alleman, K. Ramanathan, NREL, Golden CO
11:20
201.8
Cu(In,Ga)Se2, Thin Film Evolution During Growth • A Photoluminescence Study

B. Keyes, P. Dippo, J. AbuShama, R. Noufi, NREL, Golden, CO
11:35
201.9
Effect of Surface Orientation on the Growth and Properties of Cu(In,Ga)Se2

D. Liao, A. Rockett, University of Illinois, Urbana, IL

Thursday, May 23, 2002
Oral Session 202
Regency F 13:30 • 15:15
CuInSe2 and CdTe Devices I
Chairs: R. Birkmire and K. Zwiebel
13:30
202.1
Optical and Device Characterization of Thin Film Cu (InAl) Se2
W.N. Shafarman, S. Marsillac, P.D. Paulson, M. W. Haimbodi, R. W. Birkmire, Institute of Energy Conversion, University of Delaware, Newark, DE
13:45
202.2
Properties of Zn and Cd Partial Electrolyte Treated CIGS Solar Cells
K. Ramanathan, F.S. Hasoon, H. Al-Thani, M.A. Contreras, R. Noufi, J. Keane, NREL, Golden, CO
14:00
202.3
Improved Efficiency of Cu(In, Ga)Se2 Thin Film Solar Cells by Surface Sulfurization Using Wet Process
T. Nakada, K. Matsumoto, M. Okumura, M. Hongo, Aoyama Gakuin University, Tokyo, Japan
14:15
202.4
High Efficiency CdTe Polycrystalline Thin-Film Solar Cells with a Modified Sputtered-CdS Window Layer
X. Wu, R.G. Dhere, Y. Yan, R. Adams, C. Perkins, H.R. Moutinho and B. To, NREL, Golden, CO
14:30
202.5
Spectroscopic Cathodoluminescence Studies of the ZnTe:Cu Contact Process for CdS/CdTe Solar Cells

T.A. Gessert, M.J. Romero, NREL, Golden, CO
14:45
202.6
Properties of Reactively Sputtered ZnTe:N and Its Use in Recombination Junctions
J. Drayton, C. Taylor, A. Gupta, R.G. Bohn, A.D. Compaan, University of Toledo, OH; B.E. McCandless, Institute of Energy Conversion, University of Delaware, Newark, DE; and D. Rose, First Solar, Perrysburg, OH
15:00
202.7
Formation of p+ CdTe Contact with Cu2Te Electrode and Its Stability in CdTe Cells
J.H. Yun, K.H. Kim, D.Y. Lee, and B.T. Ahn, Korea Advance Institute of Science and Technology, Daejeon, Korea; T.R. Ohno, Colorado School of Mines, Golden, CO

Friday, May 24, 2002
Oral Session 203
Regency F 9:40 • 12:10
CdTe and CuInSe2 Processing and Module Development
Chairs: H. Ullal and P. Meyers
9:40
203.1
Vapor Transport Deposition of Cadmium Telluride Films
B.E. McCandless, R.W. Birkmire, W.A. Buchanan, S. Fields, G.M. Hanket, Institute of Energy Conversion, University of Delaware, Newark, DE
9:55
203.2
Advances in Continuous, In-Line Processing of Stable CdS/CdTe Devices

K.L. Barth, R.A. Enzenroth, and W.S. Sampath,Colorado State University, Fort Collins CO
10:10
203.3
Advances in Performance and High-Throughput Manufacturing of Thin-Film CdS/CdTe Modules

D. Rose, R. Powell, U. Jayamaha,M. Maltby, A. McMaster, First Solar, LLC ・Technology, Perrysburg, OH
10:25
203.4
Progress in Apollo Technology
D.W. Cunningham, M. Federick, B. Gittings, L. Grammond, S. Harrer, J. Intagliata, N. O辰onnor, M. Rubcich, D. Skinner, P. Veluchamy, BP Solar, Fairfield, CA
10:40
203.5
Start-up and Operation of an Integrated 10 MWp Thin Film PV Module Factory
D. Bonnet, S. Oelting, M. Harr, S. Will, ANTEC Solar GmbH, D-99310 Arnstadt, Germany
10:55
203.6
A Novel Ion Plating Technique for High-Quality Transparent Conducting Oxide Films
T. Sakemi, R. Chikugo, M. Tanaka, K. Awai, Sumitomo Heavy Industries, Ltd.; K. Iwata, K. Matsubara, P. Fons, S. Niki, Energy Electronics Institute, AIST, Ibaraki, Japan
11:10
203.7
Pilot-scale Manufacture of Cu(InGa)Se2 Films on a Flexible Polymer Substrate
G.M. Hanket, U.P. Singh, E. Eser, R.W. Birkmire, W.N. Shaferman, Institute of Energy Conversion, University of Delaware, Newark, DE
11:25
203.8
Pilot Line Production of CIGS Modules: First Experience of Processing and Further Developments
M. Powalla, Zentrum fur Sonnenenergie ・und Wasserstoff ・Forschung, Stuttgart, Germany; B. Dimmler, Wuerth Solar GmbH & Co. KG, Marbach am Neckar, Germany
11:40
203.9
CIGS Module Development on Flexible Substrates
S. Wiedeman, M.E. Beck, R. Butcher, I. Eisgruber, N. Gomez, B. Joshi, R.G. Wendt, J.S. Britt, Global Solar Energy, L.L.C, Tuscon, AZ
11:55
203.10
Progress in Large-area CIGS-Based Modules with Sputtered-GZO Window
K. Kushiya, S. Kuriyagawa, I. Hara, Y. Nagoya, M. Tachiyuki, Y. Fujiwara, Showa Shell Sekiyu K. K., Kanagawa, Japan

Friday, May 24, 2002
Oral Session 204
Regency F 13:30 ・ 15:15
CdTe and CuInSe2 Devices II
Chairs: W. Shaferman and T. Nakada
13:30
204.1
Comparison of Experimental Data with AMPS Modeling of the Effects of CdS Layer Thickness on the CdS/CdTe Solar Cell
A. Fahrenbruch, ALF, Inc., Redwood City, CA
13:45
204.2
Performance-limitations in Cu(In,Ga)Se2-Based Heterojunction Solar Cells
A. Rockett, University of Illinois, Urbana, IL
14:00
204.3
Damp-Heat Treatment of Cu(In,Ga)(S,Se)2 Solar Cells
C. Deibel, V. Dyakonov, J. Parisi, University of Oldenburg, Oldenburg, Germany; J. Palm, F. Karg, Siemens & Shell Solar GmbH, Munich, Germany
14:15
204.4
Correlation Between Deep Defect States and Device Parameters in CuIn0.7Ga0.3Se2 Photovoltaic Devices
J.T. Heath, J.D. Cohen, University of Oregon, Eugene, OR; W.N. Shaferman, Institute of Energy Conversion, University of Delaware, Newark, DE
14:30
204.5
Effects of Thermal Stressing on CdTe/CdS Solar Cells
B. Tetali, V. Viswanathan, D.L. Morel, C. S. Ferekides, Center for Clean Energy and Vehicles, University of South Florida, Tampa, FL
14:45
204.6
Treatment Effects on Deep Levels in CdTe Based Solar Cells
A.S. Gilmore, P. Erslev, S.D. Feldman, V. Kaydanov, T.R. Ohno, Colorado School of Mines, Golden, CO; D. Rose, First Solar, LLC, Perrysburg, OH. D.L. Young, NREL, Golden, CO
15:00
204.7
A New Thin Film CuGaSe2/Cu(In,Ga)Se2 Bifacial, Tandem Solar Cell with Both Junctions Formed Simultaneously
D.L. Young, J. Abushama, R. Noufi, X. Li, J. Keane, K. Ramanathan, T.A. Gessert, J.S. Ward, M. Contreras, M. Symko-Davies, and T.J. Coutts, NREL, Golden, CO

Tuesday, May 21, 2002
Oral Session 301
Regency F 10:30 ・ 12:15
Space Systems and Radiation Effects
Chairs: D. Marvin and J. Schwartz
10:30
301.1
First Results from the Starshine 3 Power Technology Experiment
P. Jenkins, D. Scheiman, OAI, NASA GRC, Cleveland, OH; T. Kerslake, M. Piszczor, H. Curtis, D. Wilt, R. Button, T. Miller, NASA Glenn Research Center, Cleveland, OH
10:45
301.2
Consideration on Unique Radiation-Tolerance Properties of Solar Cells Made with InP-Family
M. Yamaguchi, A. Khan, N. Dharmarasu, Toyota Tech. Inst., Nagoya, Japan
11:00
301.3
Technology For Solar Array Production on the Moon
G. A. Landis, NASA Glenn Research Center, Cleveland, OH
11:15
301.4
Photovoltaic Cell and Array Technology Development for Future Unique NASA Missions
S. Bailey, H. Curtis, M. Piszczor, NASA Glenn Research Center, Cleveland, OH; R. Surampudi, T. Hamilton, D. Rapp, P. Stella, N. Mardesich, J. Mondt, R. Bunker, Jet Propulsion Lab., Pasadena, CA; E. Gaddy, J. VanSant, C. Schwartz, Goddard Space Flight Center, Greenbelt, MD; D. Marvin, Aerospace Corp., AFRL, Albuquerque, NM; L. Kazmerzki, NREL, Golden, CO
11:30
301.5
Low Intensity Low Temperature Performance of Advanced Solar Cells
C. J. Gelderloos, K. B. Miller, Ball Aerospace & Technologies, Corp., Boulder, CO; R. J. Walters, G. P. Summers, US Naval

Research Lab., Washington, D.C.; S. R. Messenger SFA, Inc., Largo, MD
14:45

301.6

Development Activities of GaAs Space Solar Cells and Photovoltaic Assemblies for High Temperature Applications
R. Contini, G. D佴ccolti, E. Ferrando, Galileo Avionica S.p.A., Milano, Italy; R. Campesato, C. Flores, G. Gabetta, CESI S.p.A., Segrate, Italy; L. Gerlach, C. Signorini, ESA-ESTEC, The Netherlands
12:00

301.7

Dust Mitigation for Mars Solar Arrays
G. A. Landis, NASA Glenn Research Center, Cleveland, OH; and P. P. Jenkins, Ohio Aerospace Institute, NASA Glenn Research Center, Cleveland, OH

Tuesday, May 21, 2002
Oral Session 302
Regency F 13:30 • 15:15
High Efficiency Cells and Spectral Issues
Chairs: S. Kurtz and E. Gaddy
13:30

302.1

27.5% Efficiency InGaP/InGaAs/Ge Advanced Triple Junction (ATJ) Space Solar Cells For High Volume Manufacturing
M.A. Stan, D.J.Aiken, P.R. Sharps, N.S.Fatemi, F.A. Spadafora, J. Hills, H. Yoo, and B. Clevenger, Emcore Photovoltaics, Albuquerque, NM
13:45

302.2

Achieving 27.5% Triple Junction Solar Cell (TEC 3xi) with Monolithically Grown By-Pass Diode

P. K. Chiang, C.L. Chu, Y. C. M. Yeh, G. Chen, J. Wei, P. Iles and F. Ho, TECSTAR/ASD, City of Industry, CA
14:00

302.3

Advancements in GaInP2/GaAs/Ge Solar Cells-Production Status, Qualification Results and Operational Benefits
J. Granata, J. Ermer, P. Hebert, M. Haddad, R. R. King, D. D. Krut, M. S. Gillanders, N. H. Karam, B. T. Cavicchi, Spectrolab, Inc., Sylmar, CA
14:15

302.4

Temperature Dependent Spectral Response Measurements for III-V Multi-Junction Solar Cells
D. J. Aiken, M. A. Stan, C. S. Murray, P. R. Sharps, J. Hills, B. Clevenger, Emcore Photovoltaics, Albuquerque, NM
14:30

302.5

Ozone Correction for AMO Calibrated Solar Cells for the Aircraft MethodD. Snyder, NASA Glenn Research Center,

Cleveland, OH; D. A. Scheiman, P. P. Jenkins, OAI, NASA Glenn Research Center, Cleveland, OH
14:45

302.6

Influence of the Simulator Spectrum on the Calibration of Multi-junction Solar Cells under Concentration

G. Siefer, C. Baur, M. Meusel, F. Dimroth, A. W. Bett, W. Warta, Fraunhofer Institute for Solar Energy Systems, Freiburg, Germany
15:00

302.7

What is the Appropriate Reference Condition for Optimizing Concentrator Cells?

K. Emery, D. Myers, S. Kurtz, NREL, Golden, CO

Wednesday, May 22, 2002
Oral Session 303
Regency F 13:30 • 15:15
Advanced and Novel High Efficiency Concepts
Chairs: S. Ringel and P. Sharps
13:30

303.1

Development of III-V-Based Concentrator Solar Cells and Their Applications in PV Modules
A.W. Bett, F. Dimroth, G. Lange, M. Meusel, U. Schubert, G. Siefer, Fraunhofer Institute for Solar Energy Systems, Freiburg, Germany
13:45

303.2

Concentrator III-V Solar Cells: The Influence of the Wide Angle Cone of Light
C. Algora and I. Rey-Stolle, Instituto de Energia Solar, Madrid, Spain; V. Diaz, Isofoton, Spain
14:00

303.3

High Voltage, Low-Current GalnP/GalnP/GaAs/GalnNAs/Ge Solar Cells
R.R. King, P.C. Colter, D.E. Joslin, K.M. Edmondson, D.D. Krut, N.H. Karam, Spectrolab, Inc., Sylmar, CA; S. Kurtz, NREL, Golden, CO
14:15

303.4

Critical Analysis of the GalnP/GaAs/1-eV/Ge Cell for Terrestrial Concentrator Application

D.J. Friedman, J.F. Geisz, K.A. Emery, S.R. Kurtz, NREL, Golden, CO
14:30

303.5

High Performance and Radiation Resistance of GaAs-on-Si Solar Cells with Novel Structures

M. Yamaguchi, Toyota Tech Inst, Nagoya, Japan; Y. Ohmachi, Ashikaga Inst. Tech., Tochigi, Japan; Y. Kadota, NTT Photonics Labs, Atsugi, Japan; M. Imaizumi and S. Matsuda, NSDA, Ibaraki, Japan
14:45

303.6

GaNPAs Solar Cells Lattice Matched to GaP

J.F. Geisz, D.J. Friedman, NREL, Golden, CO
15:00

303.7

Radiative Coupling as a Means to Reduce Spectral Mismatch in Monolithic Tandem Solar Cell Stacks—Theoretical Considerations
A. S. Brown, M. A. Green, Centre for Third Generation Photovoltaics, University of New South Wales, Sydney, Australia

Wednesday, May 22, 2002
Oral Session 304
Regency F 17:50 • 19:35
TPV and CIGS for Space
Chairs: J. Tringe and H. Schock
17:50

304.1

Illumination-Enhanced Annealing of Electron Irradiated Cu(In,Ga)Se2 Solar Cells
A. Jasenek, K. Weinert, U. Rau, H.W. Schock, J.H. Werner, Institut fur Physikalische Elektronik, Universitat Stuttgart, Germany
18:05

304.2

AFM, Micro-PL, and CV Analyses of Culn1-xGaxS2 Thin Films Solar Cells on Stainless Steel Foil
N.G. Dhere, S. R. Ghongadi, M. B. Pandit, A. A. Kadam, Florida Solar Energy Center, Cocoa, FL
18:20

304.3

Record Electricity-to-Gas Power Efficiency of a Silicon Solar Cell Based TPV System
B. Bitnar, W. Durisch, J.C. Mayor, G. Palfinger, H.C. Sigg, D. Grutzmacher, J. Gobrecht, Paul Scherrer Institut, Villigen, Switzerland
18:35

304.4
0.74/0.55-eV GaXIn1-XAs/InAsYP1-Y Monolithic, Tandem, MIM TPV Converters: Design, Growth, Processing and Performance
R. Wehrer, B. Wernsman, Bechtel Bettis, Inc., West Mifflin, PA; M.W. Wanlass, J.J. Carapella,S.P. Ahrenkiel, NREL, Golden, CO; and C.S. Murray, Emcore, Albuquerque, NM
18:50
304.5
Multi-Wafer Growth and Processing of 0.6-eV in InGaAs Monolithic Interconnected Modules
C. Murray, F. Newman, S. Hietala, D. Aiken, J. Hills, Emcore Photovoltaics, Albuquerque, NM
19:05
304.6
GaSb-, InGaAsSb-, InGaSb-, InAsSbP-, and GeTPV Cells with Diffused Emitters
O. Sulima, , M.G. Mauk, , AstroPower, Inc., Newark, DE, A.W. Bett,, Fraunhofer ISE, Freiburg, Germany, P.S. Dutta, Rennselaer, Troy, NY, and R.L. Mueller, Jet Propulsion Laboratory, Pasadena, CA
19:20
304.7
Selective Emitters Using Photonic Crystals for Thermophotovoltaic Energy Conversion
J. Gee, J.B. Moreno, S.Y. Lin and J.G. Fleming, Sandia National Laboratories, Albuquerque, NM

Thursday, May 23, 2002
Oral Session 401
Regency GH 9:35 • 11:50

Amorphous & Microcrystalline Solar Cells & Modules
Chairs: V. Dalal and J. Meier

9:35
401.1
Improved Triple-Junction a-Si Solar Cells with Heavily Doped Thin Interface Layers at the Tunnel Junctions
W. Wang, H. Povolny, W. Du, X.B. Liao, and X. Deng, University of Toledo, Toledo, OH
9:50
401.2
Thermionic Emission Model for Interface Effects on the Open-Circuit Voltage of Amorphous Silicon Based Solar Cells
E.A. Schiff, Syracuse University, Syracuse, NY
10:05
401.3
Microstructually Engineered p-layers for Obtaining High Open Circuit Voltages in n-i-p a-Si:H Solar Cells
R.J. Koval, C. Chen, G.M. Gerreira, A.S. Ferlauto, J.M. Pearce, P.I. Rovira, R.W. Collins, and C.R. Wronski, Pennsylvania State University, University Park, PA
10:20
401.4
Correlation of the Open-Circuit Voltage Enhancement of Heterogeneous Silicon Solar Cells and the Staebler-Wronski Effect
J. Yang, K. Lord, B. Yan, A. Banerjee, S. Guha, United Solar Systems, Troy, MI
10:35
401.5
Correlation of Light-Induced Changes in a-Si:H Films with Characteristics of Corresponding Solar Cells
J.M. Pearce, R.J. Koval, R.W. Collins, C.R. Wronski, Pennsylvania State University, University Park, PA
10:50
401.6
Deposition of Microcrystalline Silicon Films and Solar Cells via the Pulsed PECVD Technique
S. Morrison, U.K. Das, A. Madan, MV Systems, Inc., Golden, CO
11:05
401.7
The Use of Plasma Emission Diagnostics to Improve the Performance of Large-area a-Si PV Modules

D.E. Carlson, M. DiColli, F. Jackson, G. Ganguly, M. Bennett, BP Solar, North American Technology Center, Toano, VA
11:20
401.8
High Efficiency Thin Film Silicon Solar Cell and Module
K. Yamamoto, A. Nakajima, M. Yoshimi, T. Sawada, S. Fukuda, K. Hayashi, T. Suezaki, M. Ichikawa, Y. Koi, M. Goto, H. Takata, and Y. Tawada, Kaneka Corp., Japan
11:35
401.9
Comparison of a-Si/a-SiGe Tandem Cell Performance Using Silane or di-silane for Depositon of the a-SiGe i-layer
G. Ganguly, D.E. Carlson, R.R. Arya, BP Solar, North American Technology Center, Toano, VA

Thursday, May 23, 2002
Oral Session 402
Regency GH 13:30 • 15:15
Optical Enhancement and Spectral Effects in Thin Film Solar Cells
Chairs: R. Collins and H. Wagner
13:30
402.1
Enhanced Light-Trapping for Micromorph Tandem Solar Cells by LP-CVD ZnO
J. Meier, J. Spitznagel, U. Graf, U. Kroll, S. Dubail, A. Shah, Institut de Microtechnique (IMT), Neuchatel, Switzerland
13:45
402.2
Optical Design and Analysis of Textured a-Si Solar Cells
S. Hegedus, P.D. Paulson, Institute of Energy Conversion, Newark, University of Delaware, Newark, DE; B. Sopori, NREL, Golden, CO
14:00
402.3
Discovery and Optimization of In-Zn-Sn-O Based Transparent Conductors by Combinatorial and Pulsed Laser Deposition Approaches
D.S.Ginley, J.A. del Cueto, J.L. Alleman, C. Warmsingh, B.M. Keyes, L.M. Gedvilas, P.A. Parilla, B. To, and J.D. Perkins, NREL, Golden, CO; D.W. Readey, M. Van Hest, Colorado School of Mines, Golden, CO
14:15
402.4
Control of the Surface Morphology of ZnO Thin Films for Solar Cells by Novel Two-Step MOCVD Process
W.W. Wenas, Institute of Technology, Bandung, Indonesia; M. Konagai, Tokyo Institute of Technology, Tokyo, Japan
14:30
402.5
The Scattering Effect of Light by Rough Surface of Solar Cell Material
J.H. Kwak, K.H. Jun and K.S. Lim, Korea Advanced Institute of Science and Technology, Daejeon, Korea
14:45
402.6
Experimental Investigation of Spectral Effects on Amorphous Silicon Solar Cells in Outdoor Operation
R. Gottschalg, D.G. Infield, M.J. Kearney, Centre for Renewable Energy Systems Technology (CREST), Loughborough University, UK
15:00
402.7
Performance of BP Solar Tandem Junction Amorphous Silicon Modules

J.H. Wohlgemuth and S.J. Ransome, BP Solar, Frederick, MD

Friday, May 24, 2002
Oral Session 403
Regency GH 9:40 • 11:55
Amorphous & Microcrystalline Materials
Chairs: D. Carlson and C. Wronski
9:40
403.1
In-Situ Characterization of the Amorphous to Microcrystalline Transition in Hot Wire CVD Growth of Si:H Using Real Time Spectroscopic Ellipsometry

D.H. Levi, B.P. Nelson, J.D . Perkins, and H.R. Moutinho, NREL, Golden, CO
9:55
403.2
Raman and IR Study of Narrow Bandgap a-SiGe and μ c-SiGe Films Deposited Using Different Hydrogen Dilution

X. Liao, H. Povolny, P. Agarwal, X. Deng, University of Toledo, Toledo, OH
10:10
403.3
Growth and Properties of High Quality a-(Si,Ge) Alloys

V. Dalal, Y. Liu, Iowa State University, Ames, IA
10:25
403.4
Combination of Plasma Diagnostics and Modelling for the Investigation of Microcrystalline Silicon Deposition
D. Mataras, E. Amanatides, D. E. Rapakoulias, Plasma Technology Laboratory, University of Patras, Patras, Greece
10:40
403.5
Amorphous and Microcrystalline Silicon Films Deposited by Hot Wire Cell Method: Application to Silicon Based Thin Film Solar Cells
Y. Ide, K. Asakusa, Y. Zhao, A. Yarnada, M. Konagai, Toyko Institute of Technology, Tokyo, Japan
10:55
403.6
Recombination Currents in μ c-Si:H Solar Cells Studied by Electrically Detected Magnetic Resonance
K. Lips, W. Fuhs, Hahn-Meitner Institut, Berlin, Germany; F. Finger, Institut fur Schicht und Ionentechnik, Julich, Germany
11:10
403.7
High-Rate Microcrystalline Silicon for Solar Cells

C. Smita,b, B.A . Korevaara,b, A.M.H.N. Petitb, R.A.C.M.M.van Swaaijb, and M.C.M. van de Sandena, aEindhoven University of Technology, Eindhoven, the Netherlands, bDelft University of Technology, The Netherlands
11:25
403.8
Microwave PECVD of Micro-Crystalline Silicon
W. Soppe, C. Devilee, ECN Solar Energy, The Netherlands; H. Donker, Delft University of Technology, The Netherlands; J. Rath, Debye Institute, Utrecht University, Utrecht, The Netherlands
11:40
403.9
A New High-rate Deposition Method for Thin Film Crystalline Si Solar Cells
R. Sharafutdinov and S. Khmel, Institute of Thermophysics, Novosibirsk, Russia; O. Semenova and S. Svitasheva, Institute of Semiconductor Physics, Novosibirsk, Russia; R. Bilyalov and J. Poortmans, IMEC, Leuven, Belgium
11:55
403.10
Characterization of Diphasic nc-Si/a-Si:H Thin Films and Solar Cells
S. Zhang, X. Liao, Y. Wang, H. Diao, Y. Xu, Z. Hu, Z Xiangbo, G. Kong, Chinese Academy of Sciences, Beijing, China

Friday, May 24, 2002
Oral Session 404
Regency E 13:30 • 15:15
Novel Thin Film Materials and Devices
Chairs: M. Konagai and G. Bauer
13:30
404.1
Charge Carrier Generation and Exciton Quenching at M3EH-PPV/Oxide Interfaces
K. Brown, Colorado School of Mines, Golden, CO; G. Rumbles, B. Gregg, P. Parilla, J. Perkins, A. Breeze, and D. Ginley, NREL, Golden, CO,
13:45
404.2
Progress Towards the Practical Implementation of the Intermediate Band Solar Cell
A. Luque, A. Marti, P. Wahnon, L. Cuadra and C. Tablero, Instituto de Energia Solar-UPM, Madrid, Spain; C. Stanley and D. Zhou, University of Glasgow, Glasgow, U.K.; A. McKee, CST Ltd. Glasgow, U.K.; R. Konenkamp. Hahn-Meitner-Institut Berlin, Germany; J. Alonso. ISOFOTON SA, Malaga, Spain
14:00
404.3
Low Temperature Electron Paramagnetic Resonance Studies and Spin Susceptibility of Phosphorus-Implanted C-60 Films for Solar Cells
N. Fahim, N. Kojima, M. Yamaguchi, Y. Ohshita, Toyota Technological Institute, Nagoya, Japan; M. Khalil, N. Yossef, National Research Center, Cairo, Egypt
14:15
404.4
Enhanced Performance of Self-Assembled Ge-Dots in Si Thin Film Solar Cells
H. Presting, J. Konle, H. Kibbel, Daimler Chrysler Research Center, Ulm, Germany; P. Uebele, G. Strobl, Heilbronn, Germany
14:30
404.5
Polycrystalline Silicon on Glass by Aluminum-Induced Crystallization
S. Gall, M. Muske, I. Sieber, W. Fuhs, Hahn-Meitner Institut, Berlin, Germany; O. Nast, BP Solar, Sunbury, UK
14:45
404.6
Thick Poly-Si Films Fabricated by Aluminum-Induced Crystallization Bi-Layer Process on Glass Substrates
P.I. Widenborg and A.G. Aberle, Centre for Photovoltaic Engineering, UNSW, Sydney, Australia
15:00
404.7
Layer Transferred Quasi Monocrystalline Porous Silicon for Thin Silicon Solar Cell
D. Majumdar, S. Chatterjee, J. Das, U. Gangopadhyay, H. Saha, IC Design and Fabrication Centre, S.K. Dutta, City College, Kolkata, India

Tuesday, May 21, 2002
Oral Session 501
Regency GH 10:30 • 12:15
Concentrator Systems
Chairs: A. Luque and V. Garboushian
10:30
501.1
Initial Results from 300 kW High-Concentration PV Installation
V. Gaboushian, D. Roubideaux, Amonix, Inc., Torrance, CA; P. Johnston, and H. Hayden, Arizona Public Service Company, Phoenix, AZ
10:45
501.2

Concepts for the Manufacture of Silicon Solar Cell Modules for Use in Concentrating Systems Up to 5X
T.M. Bruton, J. Sherborne, K. C. Heasman, BP Solar, Sunbury on Thames, UK; C. M. Ramsdale, Cavendish Laboratory, Cambridge, UK

11:00
501.3
Development of Terrestrial Concentrator Modules Using High-Efficiency Multi-Junction Solar Cells
M. J. O誰eill, A. J. McDanal, ENTECH, Inc., Keller, TX; P. A. Jaster, 3M, St. Paul, MN
11:15
501.4
Recent Developments on the Flat-Plate Micro-Concentrator Module
A. Terao, O.C.. Pujol, S. G. Daroczi, N. R. Kaminar, D. D. Smith, K. R. McIntosh, and R. M. Swanson, SunPower Corp., Sunnyvale, CA USA; P. Benitez, J. L. ﾁlvarez, J. C. Mi no, Instituto de Energia Solar, E.T.S.I. Telecomunicacion (UPM), Madrid, SP
11:30
501.5
The Development of Small Concentrating PV Systems
G. R. Whitfield, R. W. Bentley, The University of Reading, Whiteknights, Reading, UK; C. K. Weatherby, Solar Century, London, UK; and B. Clive, Optical Products Ltd., London, UK
11:45
501.6
A 2-kW Concentrating PV Array Using Triple Junction Cells
R. Sherif, A. Paredes, and H. Cotal, Spectrolab, Inc. (A Boeing Co.), Sylmar, CA; and and H. Hayden, Arizona Public Service, Phoenix, AZ
12:00
501.7
PETAL: Research Pathway to Fossil Competitive Solar Electricity
D. Faiman, S. Biryukov, and K. Pearlmutter, Dept. of Solar Energy and Environmental Physics, Ben-Gurion Univ. of the Negev, Israel

Tuesday, May 21, 2002
Oral Session 502
Regency GH 13:30 • 15:15
Inverter Technology
Chairs: R. Bonn and A. Bahaj
13:30
502.1
Impact of Inverter Configuration on PV System Reliability and Energy Production
A. Pregelj, M. Begovic, A. Rohatgi, Georgia Institute of Technology, Atlanta, GA
13:45
502.2
Technical and Safety Aspects of Non-Isolated PV Inverters
R. H. Wills, Advanced Energy, Inc., Wilton, NH
14:00
502.3
Design Considerations for Three-Phase Grid Connected Photovoltaic Inverters
R. M. Hudson, M. R. Behnke, Xantrex Technology, Inc., Livermore, CA; R. West, Xantrex Technology, San Luis Obispo, CA; S. Gonzalez, J. Ginn, Sandia National Laboratories, Albuquerque, NM
14:15
502.4
PC Software Interfaces Into AC Inverters: Opportunities, Limitations, and Required Developments
M. J. Pelosi, Maui Solar Energy Software Corp., Haiku, HI
14:30
502.5
Certification of Photovoltaic Inverters: The Initial Step Toward PV System Certification
W. Bower, Sandia National Laboratories, Albuquerque, NM
14:45
502.6
High Frequency DC Link Inverter for Grid-Connected Photovoltaic System
Y. Jung, and G. Yu, , Korea Institute of Energy Research, Taejon, Korea; J. Choi, Chungbuk National University, Chungbuk, Korea
15:00
502.7
Implementation and Testing of Anti-Islanding Algorithms for IEEE 929-2000 Compliance of Single Phase Photovoltaic Inverters
R. M. Hudson, and M.R. Behnke, Xantrex Technology, Inc., Livermore, CA; T. Thorne and F. Mekanik, Xantrex Technology, Inc. Arlington, WA, S. Gonzalez and J. Ginn, Sandia National Laboratories, Albuquerque, NM

Wednesday, May 22, 2002
Oral Session 503
Regency GH 13:30 15:15
System and Component Performance
Chairs: C. Whitaker and B. Richards
13:30
503.1
kWh/kWp Dependency on PV Technology, Balance of Systems Performance and Marketing Watts

S.J. Ransome, BP Solar, Sunbury on Thames, UK; J.H. Wohlgemuth, BP Solar, Frederick, MD
13:45
503.2
PV Hybrid System and Battery Test Results from Grasmere Idaho
T.Hund, Sandia National Laboratories, Albuquerque, NM; S. Gates, Idaho Power, Boise, ID
14:00
503.3
Experimental Optimization of the Performance and Reliability of Stand-Alone Photovoltaic Systems
D.L. King, T.D. Hund, W.E. Boyson, J.A. Kratochvil, Sandia National Laboratories, Albuquerque, NM
14:15
503.4
Comparison of PV Module Performance Before and After 11 Years of Field Exposure
A.M. Reis, N. T. Coleman, M.W. Marshall, P.A. Lehman, C.E. Chamberlin, Schatz Energy Research Center, Humboldt State University, Arcata, CA
14:30
503.5
Commonly Observed Degradation in Field-Aged Photovoltaic Modules
M.A. Quintana, D. King, Sandia National Laboratories, Albuquerque, NM; T. McMahon and C. Osterwald, NREL, Golden, CO
14:45
503.6
The PETROBRAS 40kWpAC Thin-Film Grid-Connected PV System: A Comparative Study of Four a-Si Module Types Operating in Brazil
R. Ruther, I.T. Salamoni, LabEEE, Depart. De Engenharia Civil; A. A. Monenegro, LABSOLAR, Dept. de Engenharia, Brazil; A. J. G. da Silva, and R. G. Araujo, PETROBRAS, CENPES, Rio de Janeiro, Brazil
15:00
503.7
PVMaT Advances in the Photovoltaic Industry and the Focus of Future PV Manufacturing R&D
R. L. Mitchell, C.E. Witt, H.P. Thomas, M. Symko-Davies, NREL, Golden, CO;
R. King, US DOE, Washington, D.C.;
D.S. Ruby, Sandia National Laboratories, Albuquerque, NM

Wednesday, May 22, 2002
Oral Session 504

Regency GH 17:50 • 19:35
Improving Performance and Reliability of PV Systems
Chairs: W. Bower and H. Fanny
17:50
504.1
Distributed Power and the Status of the IEEE P1547 Draft Standard for Interconnecting Distributed Resources with Electric Power Systems
H. Thomas, T. Basso, National Renewable Energy Laboratory, Golden, CO
18:05
504.2
PV Power Systems, The 2002 National Electrical Code, and Beyond
J. Wiles, W. Bower, Southwest Technology Development Institute, New Mexico state University, Las Cruces, NM
18:20
504.3
Photovoltaic Test Laboratory Accreditation and Product Certification

G. Atmaram, Florida Solar Energy Center, Cocoa, FL
18:35
504.4
PV Installations, A Progress Report
J. C. Wiles, B. Brooks, B. Schultze, New Mexico State University, Las Cruces, NM
18:50
504.5
National Practitioner Certification Versus Disparate State Requirements
M. Fitzgerald, W. Parker, Institute for Sustainable Power, Highlands Ranch, CO; J. Weissman, IREC, Latham, NY
19:05
504.6
Design of a Max Power Point Sensor for Photovoltaic Systems
J.E. Schripsema, A.J. Holmes, M.A. Johnson, N. Hafycz, and L.M. Koschier, AstroPower, Inc, Newark, DE
19:20
504.7
Low Cost AC Power Monitor for Residential PV Support
A.L. Rosenthal, J. Mani, M. Kachare, New Mexico State University, Las Cruces, NM

Friday, May 24, 2002
Oral Session 505
Regency E 9:40 • 12:10
Systems Field Experience
Chairs: H. Thomas and G. Ventre
9:40
505.1
A Utility's PV Commercialization Initiative: Progress of the LUZ Solar Program for Rural Pre-Electrification
A.S.A.C. Diniz, F.W. Carvalho, E. Franca, J.L. Tome, M.H. Villefort, C F. Camara and M..B. Delgago, Companhia Energetica de Minas Gerais-CEMIG, Belo Horizonte, Brazil
9:55
505.2
Meeting the Challenges of Using PV for Rural Internet Connectivity and Distance Education in Latin America

C.J. Hanley and M. P. Ross, Sandia National Laboratories, Albuquerque, NM; R. Foster and G. Cisneros, New Mexico State University, Las Cruces, NM, C. Rovero, and L. Ojinaga, Winrock International, Arlington, VA; and A. Verani, Enersol Assoc., N. Chelmsford, MA
10:10
505.3
Solar PV Water Pumping Comes of Age in India

T.S. Surendra, Suryovonics, Ltd., Hyderabad, India; S.V.V. Subbaraman, Polyene Group, Chennai, India10:25
505.4
Indonesian Effort to a Better Quality of Solar Home System

A. Sudradjat, Center for the Assessment and Application of Energy Conversion and Conservation Technology, Indonesia
10:40
505.5
Performance and Characterization of Building Integrated Photovoltaic Panels
A.H. Fanney, B.P. Dougherty, M.W. Davis, National Institute of Standards and Technology, Gaithersburg, MD
10:55
505.6
The UK Domestic Photovoltaic Systems Field Trial • Objectives and Initial Results
N.M. Pearsall, University of Northumbria, UK; I. Butterss, Building Research Establishment Ltd., Watford, UK
11:10
505.7
Optimization of Building Integrated Photovoltaic Systems
E.W. Smiley and L. Stamenic, British Columbia Institute of Technology, Burnaby BC, Canada
11:25
505.8
Post Installation Optimization of a Building Integrated PV System at Southampton University

A.S. Bahaj, R.M. Braid, P.A.B. James; Sustainable Energy Research Group, Southampton University, UK
11:40
505.9
A 10-kWp PV Grid-Connected Solar Plant Integrated Into the Building
N. Olariu, Universitatea Valahia, Targoviste, Romania
11:55
505.10
Performance, Costs, Operational Experience, and Lessons from Over 1100 PV Installations
S. Hester, T. Willey, Solar Electric Power Association, Washington, D.C.

Tuesday, May 21, 2002
Poster Session 1P1
Regency E 15:40 • 17:40
Silicon Materials & Processing I
Chairs: R. Sinton and T. Jester
1 P1.1
Accurate Evaluation of Minority Carrier Diffusion Length in Thin Film Single Crystalline Silicon Solar Cells
Y. Yamamoto, Y. Ishikawa, K. Nishioka, Y. Uraoka, T. Fuyuki, Nara Institute of Science and Technology, Nara, Japan
1 P1.2
Recent Developments in Electrodeposited Silicon Solar Cells
H. Somberg, Global PV Specialists, Woodland Hills, CA
1 P1.3
Comparative Study of ZnO:A1 Films on Si and Glass Prepared by RF Magnetron Sputtering at Room Temperature
D. Song, J. Xia, E-C. Cho and A.G. Aberle, Centre for Photovoltaic Engineering, University of New South Wales, Sydney, Australia
1 P1.4
Comparison of Dielectric Surface Passivation of Monocrystalline and Multicrystalline Silicon
J. Brody and A. Rohatgi, Georgia Institute of Technology, Atlanta, GA
1 P1.5
Si/Multicrystalline-SiGe Heterostructure as a Candidate for Solar Cells with High Conversion Efficiency
N. Usami, T. Takahashi, K. Fujiwara, T. Ujihara, G. Sazaki, Y. Murakami, K. Nakajima, Institute for Materials Research, Tohoku University, Sendai, Japan
1 P1.6
Rapid Thermal Processing for PECVD SiN-Induced

Hydrogenation of High-Efficiency EFG Silicon Solar Cells
J. W. Jeong, Y. H. Cho, A. Rohatgi, University Center of Excellance for Photovoltaic Research and Education, Georgia Institute of Technology, Atlanta, GA; M.D. Rosenblum, B.R. Bathey, and J.P. Kalejs, ASE Americas, Inc., Billerica, MA

1 P1.7
A Thermal Dynamical Boron Getter (pp+ Getter) in Fe-Contaminated Mass Production of the Boron Diffused n+pp+BSF Bifacial Silicon Solar Cells
T. Johge, and I. Araki, Hitachi Ltd., , Ibaraki, Japan; T. Uematsu, Hitachi, Ltd.,, Tokyo, Japan; H. Nakashima, Kyushu University, Fukuoka, Japan; and K. Matsukuma, Sojo University, Kumamoto, Japan

1 P1.8
Surface Texturing for Silicon Solar Cells Using Reactive Ion Etching Technique
K. Ganesan, M. Alkaisi, University of Canterbury, Christchurch, New Zealand. and A. Bittar, Industrial Research Limited, Wellington, New Zealand

1 P1.9
Efficient Surface Passivation by Silicon Nitride Using a Large Area Deposition System
WW. Kintzel, M. Bail, R. Auer, R. Brendel, Bavarian Center for Applied Energy Research (ZAE Bayern), Erlangen, Germany
1 P1.10
Silicon Solar Cells with a Back Surface Field Formed by Selective Doping
L. Kreinin, N. Bordin, J. Broder, N. Eisenberg, and G. Arabito, Jerusalem College of Technology, Jerusalem, Israel; M. Izzi, E. Salza, and L. Pirozzi, ENEA Casaccia, Roma, Italy

1 P1.11
Carrier Density Imaging (Dl): A Spatially Resolved Lifetime Measurement Suitable for In-Line Process Control
J. Isenberg, S. Riepe, S. W. Glunz, and W. Warta, Fraunhofer ISE, Freiburg, Germany
1 P1.12
A Method for Industrial Characterisation of Crystalline Silicon Wafers
G. Coletti, S. Deluliis, M. Galluppi, and F. Ferrazza, Eurosolar, Rome, Italy
1 P1.13
Commercialization of a Silicon Nitride Co-fire through (SINCOT) Process for Manufacturing High Efficiency Mono-Crystalline Silicon Solar Cells
S. Narayanan, BP Solar International, Frederick, MD
1 P1.14
A Study on Cu Metallization for Crystalline Si Solar Cells
J. S. You, Seoul National University, South Korea, Korea
1 P1.15
Single High Temperature Step Selective Emitter Structures Using Spin-On Dopant Sources
P. J. Cousins, C. B. Honsberg, Centre for Photovoltaics, University of New South Wales, Sydney, Australia
1 P1.16
Phosphorus Gettering in Multicrystalline Silicon Studied by Neutron Activation Analysis
D. MacDonald and A. Cuevas, Centre for Sustainable Energy Systems, , FEIT, The Australian National University, Acton, Australia; A. Kinomura, , National Institute of Advanced Industrial Science and Technology, Osaka, Japan; and Y. Nakano, Research Reactor Institute, Kyoto University, Osaka, Japan
1 P1.17
Epitaxial Technology of Si/CoSi2/Si Layers for Solar Cell Application
Y. Tsuji, S. Noda, M. Mizukami, and H. Komiyama, The University of Tokyo, Tokyo, Japan
17:40

Wednesday, May 22, 2002
Poster Session 1P2
Regency E 10:10 ・12:00

Silicon Materials & Processing II
Chairs: J. Gee and P. Verlinden
1 P2.1
High-density Hollow Cathode Plasma Etching for Large Area Multicrystal Silicon Solar Cell
W. J. Lee, J. H. Lee, U. Gangopadhyay, J. Yi, School of Electrical and Computer Engineering, Sungkyunkwan University, Suwan, S. Korea
1 P2.2
Investigations on Laser Fired Contacts for Passivated Rear Solar Cells
E. Schneiderlochner, A. Grohe, R. Preu, S. W. Glunz, and G. Willeke, Fraunhofer ISE, Freiburg, Germany
1 P2.3
Higher Efficiency for Thin Multi Crystalline Silicon Solar Cells by Improving the Rear Surface Passivation
C. J. J. Tool, P. Manshanden, A. R. Burgers, and A. W. Weeber, ECN Solar Energy, The Netherlands
1 P2.4
Closed Recycle CVD Process for Mass Production of SOG-Si from MG-Si
S. Noda, K. Hagiwara, O. Ichikawa, K. Tanabe, T. Yahiro, H. Ohkawa, and H. Komiyama, The University of Tokyo, Japan
1 P2.5
IBICC Studies of Polycrystalline Silicon
B. Pivac, R. Boskovic Institute, Zagreb, Croatia
1 P2.6
Defect Density of Crystalline Si Films Fabricated by High Speed Zone Melting Crystallization for Solar Cells
S. Yokoyama, M. Ihara, H. Hashizume, and C. Yokoyama, Institute of Multidisciplinary Research for Advanced Materials, Tohoku University, Sendai, Japan; H. Komiyama, University of Tokyo, Japan
1 P2.7
Ribbon-Growth-on-Substrate: Progress in High-Speed Crystalline Silicon Wafer Manufacturing
A. Sch ecker, L. Laas, A. Gutjahr, and P. Wyers, Energy Research Center of the Netherlands, ECN, Petten, The Netherlands; and A. Reinink, B. Wiersma, S脱nergy B. V., Rotterdam, The Netherlands
1 P2.8
Selective Junction Separation Techniques for Multi-Crystalline Silicon Solar Cells
S. De Wolf, C. Allebe, E. Van Kerschaver, H. F. W. Dekkers, J. Szlufcik IMEC vzw, Leuven, Belgium
1 P2.9
Silicon Solar Cells Textured by Low Damage RIE with Natural Lithography
P. Manshanden, A. R. Burgers, A. W. Weeber, ECN Solar Energy, The Netherlands; W. A. Nositschka, O. Voigt, Institute of Semiconductor Technology II, Aachen, Germany
1 P2.10
Separation of Bulk Diffusion Length and Rear Surface Recombination Velocity in SR-LBIC Mappings
J. Isenberg, O. Bartels, and W. Warta, Fraunhofer ISE, Freiburg, Germany
1 P2.11
Stress Diagnostics in Multicrystalline Silicon Wafers Using an Acoustic Technique
A. Belyaev, S. Lulu, I. Tarasov, S. Ostapenko, Center for Microelectronics Research, University of S. Florida, Tampa,

FL; J. P. Kalejs, ASE Americas, Billerica, MA
1 P2.12
Bow Reducing Factors for Thin Screenprinted mc-Si Solar with A1BSF
A. Schneider, C. Gerhards, P. Fath, E. Bucher, University of Konstanz, Konstanz, Germany; R.J.S. Young, J.A. Raby, DuPont iTechnologies, Bristol, UK; A.F. Carroll, DuPont iTechnologies, Research Triangle Park, NC
1 P2.13
Optimizing the Front Side Metallization Process Using the Corescan
A. S. H. van der Heide, J. H. Bultman, J. Hoornstra, A. Schonecker, G. P. Wyers, W. C. Sinke, ECN Solar Energy, The Netherlands
1 P2.14
Comparison of Remote and Direct Plasma Silicon Nitride
A. Hauser, P. Fath, and E. Bucher, University of Konstanz, Germany; A.W. Weeber, W. J. Soppe, ECN Solar Energy, The Netherlands

1 P2.15
High Temperature Light Induced Degradation in Czochralski Silicon
B. Damiani, M. Hilali, A. Rohatgi, Georgia Institute of Technology, Atlanta, GA

1 P2.16
Hot Melt Ink Technology for Crystalline Silicon Solar Cells
T. Williams, K. McVicker, A. Shaikh, Ferro Electronic Materials, Vista, CA; T. Koval, S. Shea, B. Kinsey, D. Hetzer, BP Solar, Frederick, MD
1 P2.17
Investigation of Screen-Printed Selective-Emitter Solar Cells Using Self-Aligned Self-Doping Paste
M. Hilali, J.-W. Jeong, and A. Rohatgi, Georgia Institute of Technology, Atlanta, GA; and D. L. Meier, Ebara Solar, Inc., Belle Vernon, PA

Wednesday, May 22, 2002
Poster Session 1P3
Regency E 15:35 • 17:30
Silicon Processing, Devices & Modules
Chairs: R. Mitchell and W. Sinke
1 P3.1
Production of Low-Cost Solar Grade (SoG) Silicon Feedstock
C.P. Khattak, D.B. Joyce and F. SchmidCrystal Systems, Inc., Salem, MA
1 P3.2
Monitoring Texture Etching Process in Si Solar Cell Production
B.L. Sopori, Y. Zhang, J. Madjdpour, M. J. Romero, NREL, Golden, CO
1 P3.3
A Determination of Key Sources of Variation Affecting Ingot Lifetime
J. Nickerson, L. Mandrell, Siemens Solar Industries, Camarillo, CA; T.H. Wang, T.F. Ciszek, NREL, Golden, CO
1 P3.4
Implied Voc and Suns Voc Measurements in Multicrystalline Solar Cells
S. Bowden, V. Yelundur, A. Rohatgi, Georgia Institute of Technology, Atlanta, GA
1 P3.5
Passivation Property of SiNx:H/SiO2 Double Layer Formed by Ammonia Microwave Remote Plasma CVD Method
Y. Fushimi, T. Wake, M. Fujiware, T. Saitoh, K. Kamisako, Tokyo University, Tokyo, Japan
1 P3.6
Narrower Efficiency Distribution for Multicrystalline Silicon Solar Cells by Double-Side Emitter Diffusion
M.J.A.A. Goris, A. W. Weeber, J. H. Bultman, ECN Solar Energy, The Netherlands
1 P3.7
Multicrystalline Silicon for Solar Cell
A.I. Nepomnyaschikh, and A.A. Nepomnyaschikh, Institute of Geochemistry, Siberian Branch, Russian Academy of Sciences; V.A. Fedosenko and V.P. Eremin, Kremniy Ltd., Russia
1 P3.8
Processing of Crystalline Silicon Solar Cells in High Throughput Production Tools
J.A. Bragagnolo, J. Akita, and H. Sato, NPC America Corp., Dumont, NJ; Y. Chikaki, T. Hashimoto, and M. Ito, NPC, Inc.; Toyko, JapanI. Sugiyama, NPC Europe, Bruesseler, Germany
1 P3.9
Control Charts and Efficient Sampling Methodologies in the Field of Photovoltaics
C. Allebe S. De Wolf, and J. Szlufcik, IMEC vzw, Heverlee, Belgium; B. Govaerts, Institut de Statistique, Universite Catholique de Louvain-la-Neuve, Belgium
1 P3.10
Recent Progress on 15-MW Silicon Film • Solar Cell Manufacturing Systems
S. Abraham, G. Addison, K. Allison, J. Culik, F. Faller, I. Goncharovsky, J. Rand, A. Barnett, AstroPower, Inc., Newark, DE
1 P3.11
Light-Induced Lifetime Degradation of Commercial Multicrystalline Silicon Wafers
M. Dhamrin, T. Akihide, H. Hashigami, and T.Saitoh, Tokyo A&T University, Tokyo, Japan
1 P3.12
Front Grid Design for Solar Cell Using Plated Contact
U. Gangopadhyay, K. Kim and J.Yi, Sungkyunkwan University, Suwan, South Korea; H. Saha and S.K. Dutta, IC Design & Fabrication Centre, Jadavpur University, Kolkata, India; K. Chakrabarty, Photon Semiconductor & Energy Company, Suwan, South Korea
1 P3.13
Conductive Adhesives for Low-Stress Interconnection of Thin Back-Contact Solar Cells
D.W.K. Eikelboom, J.H. Bultman, A. Schonecker, and M.H.H. Meuwissen, ECN Solar Energy, The Netherlands; M.A.C.J. van den Nieuwenhof, TNO Institute of Industrial Technology, The Netherlands; D. L. Meier, EBARA Solar, Belle Vernon, PA
1 P3.14
Contact Shadowing Losses Reduction by Fine Line Screen Printing
M.A. Butturi, M. Stefancich,D. Vincenzi, G. Martinelli, INFM-Dipartimento di Fisica, Universita di Ferrara, Italy; L. Pirozzi, G. Arabito, M. Izzi, P. Mangiapane, ENEA Casaccia, Roma, Italy
1 P3.15
Rapid Thermal Processing for Front and Rear Contact Passivation
S. Bowden, D.S. Kim, C. Honsberg and A. Rohatgi,Georgia Institute of Technology, Atlanta, GA
1 P3.16
Development of Automated Photovoltaic Module Manufacturing Processes
M.J. Nowlan, J.M. Murach, S.F. Sutherland, S.B. Moore, D.C. Miller, S.J. Hogan, Spire Corp., Bedford, MA

1 P3.17

Cell Binning Methods for Minimization of Mismatch Losses in Si-Based Modules

H. Field, PV Measurements, Boulder, CO; A. M. Gabor, Evergreen Solar, Marlboro, MA

1 P3.18

BIDIM2: Numerical Simulator of solar Cells in Two Dimensions

S. Uriarte, C.Ikarau, J.C. Jimeno and V. Martinez, Teknologia Mikroelecktronikoaren Instituta, Bilbao, Spain

17:30

Thursday, May 23, 2002

Poster Session 1P4 Regency E 16:00 ・17:45

Silicon Devices

Chairs: P. Basore and T. Wang

1 P4.1

Current-induced Performance Degradation of Cz-Si Solar Cells

H. Hashigami, Y. Itakura, T. Saitoh, Tokyo University of Agriculture and Technology, Tokyo, Japan

1 P4.2

Lock-In Thermography Investigation of Shunts in Screen-Printed and PERL Solar Cells

O. Breitenstein, J. P. Rakotoniaina, S. Neve, Max Planck Institute of Microstructure Physics, Halle, Germany; M.A. Green, J. Zhao, A. Wang, University New S. Wales, Sydney, Australia; G. Hahn, Universitat Konstanz, Konstanz, Germany

1 P4.3

Local Mapping of the Oxygen Boron Complex in CZ PERL Solar Cells by Lock-in Thermography

J.P. Rakotoniaina, O. Breitenstein, Max Planck Institute of Microstructure Physics, Halle, Germany; M.A. Green, J. Zhao, UNSW, Australia

1 P4.4

Lifetime and Efficiency Limits of Crystalline Silicon Solar Cells

M.J. Kerr, and A. Cuevas, Australian National University, Canberra, Australia

1 P4.5

10.21% Polycrystalline Silicon Thin Film Solar Cells on SiO2-Covered c-Si Substrates

X. Ying, Y. Yuan, L. Zhongming, , Beijing Solar Energy Research Institute, Beijing, China; L. Xudong and Z. Hongyu, Beijing Normal University, Beijing, China

1 P4.6

15.12% High Efficient Silicon Thin Film Solar Cells on p++c-Si Substrates Prepared by RTCVD

L. Zhongming, X. Ying, L. Xudong, H. Yang, Y. Yuan, Beijing Solar Energy Research Institute, Beijing, China

1 P4.7

Recombination Parameters of Illuminated BiFacial Silicon Solar Cells with n+-p-p+ Structure

L. Kreinin, N. Bordin, N. Eisenberg, Jerusalem College of Technology, Jerusalem, Israel

1 P4.8

Phase-sensitive LBIC Analysis ・An Effective Means to Investigate Local Impedances

Th. Pernau, B. Fischer, P. Fath, E. Bucher, Universitat Konstanz, Konstanz, Germany

1 P4.9

Shunts Imaging in Solar Cells Using Low-Cost Commercial Liquid Crystal Sheets

C. Ballif, C. Peters, D. Borchert, Fraunhofer ISE, Gelsenkirchen, Germany; J. Isenberg, S. Riepe, Fraunhofer ISE, Freiburg, Germany

1 P4.11

High-efficiency Silicon Solar Cells for Low-illumination Applications

S.W. Glunz, F. J. Kamerewerd, J. Knobloch, D. Kray, A. Leimenstoll, F. Lutz, D. O˚wald, R. Preu, E. Sch臓fer, C. Schetter, H. Schmidhuber, H. Schmidt, C. Vorgrimler, G. Willeke, Fraunhofer ISE, Freiburg, Germany

1 P4.12

Scanning IQE-Measurement for Accurate Current Determination on Very Large Area Solar Cells

B. Fischer, M. Keil, P. Fath, E. Bucher, University of Konstanz, Faculty of Physics, Konstanz, Germany

1 P4.13

Substrate Thickness Optimization for Crystalline Silicon Solar Cells

A. Ristow, A. Rohatgi, Georgia Institute of Technology, Atlanta, GA

1 P4.14

Effect of Oxide Thickness and Substrate Orientation on the Photovoltaic Characteristics of Al/SiO2/p-Si MIS Diodes

J. Majhi, IIT, Madras, India

1 P4.15

Analysis of Fill Factor Losses Using Current-Voltage Curves Obtained Under Dark and Illuminated Conditions

P. Hacke, D.L. Meier, EBARA Solar, Inc., Belle Vernon, PA

1 P4.16

Nanoscale Si-layered Systems for 3rd Generation Photovoltaics

Z.T. Kuznicki and M. Ley, Laboratoire PHASE, CNRS-STIC, Strasbourg, FR

1 P4.17 Comparison Between Phosphorus and Boron Passivated Gaussian Profile Homogeneous Emitter Solar Cells

M. Cid and N. Stem, Laborat io de Microeletr ica ・Depto de Engenharia Eletr ica, Escola Polit 馗nica, da Universidade de S縊 Paulo, S縊 Paulo, Brazil

Wednesday, May 22, 2002

Poster Session 2P1 Regency G 10:10 ・12:00

CuInSe2 and CdTe Windows and Contacts

Chairs: A. Compaan and V. Kapur

2 P1.1

Co-sputtered Cd2SnO4 Films as Front Contacts for CdTe Solar Cells

R. Mamazza, S. Yu, D.L. Morel, and C.S. Ferekides, Center for Clean Energy and Vehicles, University of South Florida, Tampa, FL

2 P1.2

Transparent Conducting Oxides Based on Cd-In-O

R. Mamazza, U. Balasubramanian, D. L. Morel, C.S. Ferekides, Center for Clean Energy and Vehicles, University of South Florida, Tampa, FL

2 P1.3

Synthesis of Polycrystalline ZnS0.5 SeO.5 Layers by Chemical Spray Deposition Process

K.T. Reddy, T.B.S. Reddy, P.P. Reddy, Sri Venkateswara University, India; I. Forbes and R. W. Miles, University of Northumbria, Newcastle, UK

2 P1.4

Physical Properties of CdS Thin Films Grown by Different Techniques: A Comparative Study

A Morales-Acevedo, CINVESTAV del IPN, Mexico; O. Vigil-Galan, Facultad de Fisica-IMREUniversidad de la Habena, Cuba; G. Contreras-Puente, Escuela Superior de Fisica y Mathematicas, Mexico;J. Vidal-Larramendi, Facultad de Fisica IMRE, Universidad de la Habana, Cuba, A. Escamilla-Esquivel, H. Hernandez-Contreras, F. Cruz-Gandarilla, Escuela Superior de Fisica y Mathematicas, Mexico; A. Arias-Carbajal, Dept. de Quimica Inorganica, Universidad de la Habana, Cuba

2 P1.5

Study of New Indium Sulphide Derivative for Buffer Layer Application
N. Barreau, J.C. Bernede, C. Deudon, L. Brohan, A. Barreau, University of Nantes, France; S. Marsillac, and W.N. Shafarman, Institute of Energy Conversion, University of Delaware, Newark, DE
2 P1.6
Investigation of Chemical-Bath Deposited ZnS Buffer Layers for Cu(InGa)Se2 Thin Film Solar Cells
B. Sang, W.N. Shafarman, R.W. Birkmire, Institute of Energy Conversion, University of Delaware, Newark, DE
2 P1.7
High Efficiency Chalcopyrite Solar Cells with ILGAR-ZnO WEL ・Device Characteristics Subject to the WEL Constitution
M. B舐, Ch.-H Fischer, H.-J Muffler, M.C. Lux-Steiner, Hahn-Meitner-Institut Berlin, Germany; B. Leupolt, Fraunhofer Institut fur Werkstoff und Strahltechnik, Dresden, Germany; F. Karg, Siemens & Shell Solar GmbH, Munich, Germany
2 P1.8

CIGS Devices with ZIS, In2S3, and CdS Buffer Layers
A.E. Delahoy, M. Akhtar, J. Cambridge, R. Govindarajan, S. Guo, Energy Photovoltaics; M. Romero, NREL, Golden, CO
2 P1.9

CdTe Thin Film Solar Cells with ZnSe Buffer Layer
G. Gordillo, C. Calderon, H. Infante, Universidad Nacional de Colombia, Bogota, Columbia
2 P1.10

Chemical Bath Deposited (CBD) ZnS Buffer Layers for CIGS Solar Cells
L.C. Olsen, S. Kundu, Washington State University, Richland, WA
2 P1.11

Role of Buffer Layers in CIS-Based Solar Cells
L.C. Olsen, P. Eschbach, S. Kundru, Washington State University, Richland, WA
2 P1.12

Cd Free CIGS Solar Cells Fabricated by Dry Processes
T. Negami, T. Santoh, S. Shimakawa, S. Hayashi, Y. Hashimoto, Matsushita Electric Industrial Co., Ltd., Kyoto, Japan; T. Aoyagi, Ritsumeikan University, Siga, Japan
2 P1.13

CuxO a Possible Contacting Material to p-CdTe
N. K. Mondal, S. Das, J. Pal, P. Banerjee, and B. Ghosh ., Jadavpur University, Kolkata, India

Thursday, May 23, 2002
Poster Session 2P2 Regency F 16:00 ・17:45
CdTe and CuInSe2 Materials and Deposition
Chairs: C. Ferekides and J. Sites
2 P2.1

Molecular Level Pathway to CIS Deposition without Post-Treatments
S. Menezes, InterPhases Research, Thousand Oaks, CA
2 P2.2

Microtexture Determination in CdTe Thin Films by Electron Back-Scatter Diffraction
L.R. Cruz, A.L. Pinto, M.S. Soares, Instituto Militar de Engenharia, Rio de Janeiro, Brazil; H. R. Moutinho, R.G. Dhere, NREL, Golden, CO
2 P2.3

Preparation and Characterization of CuAlSe2 Thin Films Prepared by Co-Evaporation
Y.B.K. Reddy, V.S. Raja, Solar Energy Laboratory, Tirupati, India

2 P2.4

Vapor Chloride Treatment Studies for CdTe/CdS Solar Cells
H. Zhao, V. Palekis, P. Selvaraj, D.L. Morel and C.S. Ferekides, Center for Clean Energy and Vehicles, , University of South Florida, Tampa, FL
2 P2.5

Thin Film CuInS2 Prepared by Spray Pyrolysis with Single-Source Precursors
M.H.-C. Jin K.K. Banger, Ohio Aerospace Institute, J.D. Harris, J.E. Cowen, Cleveland State University, and A.F. Hepp, NASA Glenn Research Center, Cleveland, OH
2 P2.6

Rapid Thermal Processing of CIS Precursors
L.L. Kerr, S. Kim, S. Kincal, S. Yoon, M. Ider and T. Anderson, University; of Florida, Gainesville, FL; A. Chang, Oregon State University, Corvallis, OR
2 P2.7
Cuprous Selenide Defect Structure by Coulometric Titration and EMF Measurements on Copper Indium Selenium System
M. Ider, L.L. Kerr, B.J. Stanberry and T.J. Anderson, University of Florida, Gainesville, FL; R. Pankajavalli, Indra Gandhi Centre for Atomic Research, India; W. Zhuang, General Research Institute for Nonferrous Metals, Beijing, China
2 P2.8

Non-Vacuum Processing of CIGS Solar Cells
C. Eberspacher, K. Pauls, J. Serra, Unisun, Newbury Park, CA
2 P2.9

Non-Vacuum Processing of CIGS Solar Cells on Rigid and Flexible Substrates
V.K. Kapur, A. Bansal, and P. Le, International Solar Electric Technology, Inc.,(ISET), Inglewood, CA
2 P2.10

Copper Indium Diselenide Solar Cells Prepared by Electrodeposition
D. Guimard, P.P. Grand, P. Cowache, J_F. Guillemoles, D. Lincot, Laboratoire d脱lectrochimie , Paris, FR; M.B. Farah, M. Mah・nbsp; S. Taunier, EDF-R&D, Moret sur Loing; P. Mogensen, St. Gobain Recherche, Aubervilliers, France
2 P2.11
Material and Device Properties of In-Line Cu(In,Ga)Se2 Deposited at Different Deposition Temperatures
M. Lammer, R. Kniese, M. Powalla, Zentrum fur Sonnenenergie und Wasserstoff, Stuttgart, Germany
2 P2.12 Open Circuit Voltage From Quasi-Fermi Level Splitting in Polycrystalline Cu(In,Ga)Se2 Thin Films with Lateral Sub-Micron Resolution by Photoluminescence
G.H. Bauer, K. Bothe, R. Bruggemann, T. Unold, FB Physics, CvO University, Oldenburg, F.R. Germany
2 P2.13 Importance of Air Ambient during CdCl2 Treatment of Thin Film CdTe Solar Cells Studied Through Temperature Dependent Admittance Spectroscopy
P. Nollet, M. Burgelman, S. Degrave, ELIS, University of Gent, Belgium; and J. Beier, Antec Technology GmbH, Arnstadt, Germany
2 P2.14 Micrononuniformity Effects in Thin-Film Photovoltaics
V.G. Karpov, A.D. Compaan, and D. Shvydka, University of Toledo, OH
2 P2.15 External Bias Effect on Junction Photoluminescence in CdS/CdTe Solar Cells
D. Shvydka, A.D. Compaan, V.G. Karpov, University of Toledo, Toledo, OH

Tuesday, May 21, 2002
Poster Session 2P3 Regency H 15:40 ・17:40
CuInSe2 and CdTe Devices and Characterization
Chairs: B. McCandless and T. Gessert

2 P3.1

Metal-Substrate Roughness Effects on CIGS-based PV Devices

W.K. Batchelor, I. L. Repins, M. E. Beck, and J. Britt, Global Solar Energy, Littleton, CO; and F. Hasoon, NREL, Golden, CO

2 P3.2

The Effect of Mo Back Contact on Na Out-Diffusion and Device Performance of Mo/Cu (In,Ga)Se2/CdS/ZnO Solar Cells

H. A. Al-Thani, F. S. Hasoon, S. Asher, M. Young, J. L. Alleman, and M. M. Al-Jassim, NREL, Golden, CO; and D. L. Williamson, Colorado School of Mines, Golden, CO

2 P3.3

Development of II-VI High Band Gap Devices for High Efficiency Tandem Solar Cells

P. Mahawela, C.S. Ferekides and D.L. Morel, Center for Clean Energy and Vehicles, University of South Florida, Tampa, FL

2 P3.4

Incorporation of Group-IIA Elements Into Cu(In,Ga)Se2 Polycrystalline Thin-Films

M.A. Contreras, K. Ramanathan, R. Noufi, M. Romero, NREL, Golden, CO

2 P3.5

11% Efficiency on CIGS Superstrate Solar Cell Without Sodium Precursor

F.J. Haug, H. Zogg, A. N. Tiwari, Swiss Federal Institute of Technology, Zurich, Switzerland

2 P3.6

Estimation of Diffusion Lengths in CuInSe2-based Cells Using the Photocurrent-Capacitance Method

C.H. Champness, McGill University, Montreal, Quebec, Canada

2 P3.8

Identification of Defect Levels in CdTe/CdS Solar Cells Using Deep Level Transient Spectroscopy

V. Komin, V. Viswanathan, B. Tetali, D. L. Morel and C. S. Ferekides, Center for Clean Energy and Vehicles, Univ. of South Florida, Tampa, FL

2 P3.9

Deep Level Transient Spectroscopy and Capacitance-Voltage Measurements of Cu(In,Ga)Se2 Solar Cells

J. AbuShama, Colorado School of Mines, Golden, CO; S. Johnston and R. Noufi, NREL, Golden, CO

2 P3.10

An Alternative Model For V, G and T Dependence of CdTe Solar Cells IV Characteristics

G. Agostinelli, MCP/ISC IMEC vzw, Leuven, Belgium; D. L. Batzner, Thin Films Physics Group, ETH Zurich, Switzerland

2 P3.11

Device Modeling and Simulation of CIS-based Solar Cells

C.H. Huang, S. S. Li, and T.J. Anderson, University of Florida, Gainesville, FL

2 P3.12

Capacitance-Frequency Analysis of CdTe Photovoltaics

D. Shvydka, First Solar LLC, Perrysburg, OH and University of Toledo, OH; U. Jayamaha, First Solar LLC, Perrysburg, OH; V. G. Karpov, University of Toledo, Toledo, OH

2 P3.13

Capacitance Measurements on ZnO/CdS/Cu(In1-xGax)Se2 Solar Cells

H. P. Wang, S. Shih, McGill University, Montreal, Quebec, Canada

2 P3.14

Effect of Back-Contact Copper Concentration on CdTe Cell Operation

J. R. Sites, A.O. Pudov, S.H. Demtsu, M. Gloeckler, K. L. Barth, R. A. Enzenroth and W. S. Sampath, Colorado State University, Ft. Collins, CO USA

2 P3.15

Interface Properties of CIGS(S)/Buffer Layers Formed by the Cd-Partial Electrolyte Process

P.K. Johnson, A.O. Pudov, J.R. Sites, Colorado State University, Ft. Collins, CO; K. Ramanathan, F. S. Hasoon, NREL, Golden, CO; and D. E. Tarrant, Siemens Solar Industries, Camarillo, CA

Tuesday, May 21, 2002

Poster Session 3P1 Regency F 15:40 • 17:40

High Efficiency and TPV Cells and Spectral Issues

Chairs: D. Aiken and J. Granata

3 P1.1

Study of P-on-N GaInP2/GaAs Tandem Cells

M.B. Chen, Z.W. Zhang, J.F. Lu ,L.X. Wang, and W.Y. Chi; Shanghai Institute of Space Power Sources, Shanghai, China; X. Xiang ,W .Du, X. Liao, Institute of Semiconductors, Chinese Academy of Sciences, Beijing, China

3 P1.2

The Performance of Advanced III-V Solar Cells

R.L. Mueller, Jet Propulsion Lab, California Institute of Technology Pasadena, CA; E.M. Gaddy, NASA Goddard Space Flight Center, Greenbelt, MD

3 P1.3

Monolithic Multi-cell GaAs Laser Power Converter with Very High Current Density

D. Krut, R. Sudharsanan, W. Nishikawa, T. lsshiki, J. Ermer, N. Karam, Spectrolab, Inc., Sylmar, CA

3 P1.4

AM0 Calibration of 34% Efficient Mechanically Stacked GaInP/GaAs-GaSb Circuits

L. M. Fraas, J. Avery, J. X. Crystals, Issaquah, WA; D. Scheiman, NASA Glenn, Cleveland, OH

3 P1.5

Development of the Ultra-Light Stretched Lens Array

M.J. O'Neill and A.J. McDanal, ENTECH, Inc., Keller, TX; P.J. George and M.F. Piszczor, NASA Glenn, Cleveland, OH; M.I. Eskenazi, and M.M. Botke, ABLE Engineering, Goleta, CA; H.W. Brandhorst, Space Power Institute, Auburn University, AL;D.L. Edwards, NASA Marshall, Huntsville, AL; P.A. Jaster, 3M Center, St. Paul, MN

3 P1.6

Fabrication of High Efficiency, III-V Multi-Junction Solar Cells for Space Concentrators

A. Stavrides, G. Kinsey, R.R. King, P. Colter, N. Karam, Spectrolab, Sylmar,CA; M.J. O'Neill and A.J. McDanal, ENTECH, Inc., Keller, Texas

3 P1.7

Japanese R&D Activities of Multi-Junction and Concentrator Solar Cells

M. Yamaguchi, K. Araki, Toyota Technical Institute, Nagoya, Japan

3 P1.8

Proposed Reference Spectral Irradiance Standards to Improve Photovoltaic Concentrating System Design and Performance Evaluation

D. Myers, K. Emery, NREL, Golden, CO; C. Gueymard, Consultant, Bailey, CO

3 P1.9

Using A Natural AM1.5G Spectrum to Help Define an AM1.5D Spectrum Appropriate for CPV Purposes

D. Faiman, Dept. of Solar Energy and Environmental Physics, Ben-Gurion University of the Negev, Israel; S. Jacob, Brown University, Providence, RI

3 P1.10

Criteria for the Design of GaInP/GaAs Tandem Cells to Optimize their Performance Outdoors

W. E. McMahon, S. Kurtz, K. Emery, and M. Young, NREL, Golden, CO

3 P1.11
Direct Normal Solar Irradiance Resource Assessment 柚 easurement Uncertainties and Modeling Methods
T. Stoffel, D. Renne, B. Marion, R. George, D. Heimiller, NREL, Golden, CO; R. Perez, State University of New York, Albany, N.Y.
3 P1.12
Design, Analysis and Testing of the CellSaver Concentrator for Spacecraft Solar Arrays
M. Eskenazi, ABLE Engineering, Goleta, GA
3 P1.13
Thin Semiconducting Layers as Selective Emitters in Thermophotonic System
K. L. Lin, K. R. Catchpole, T. Trupke, M. A. Green, A.G. Aberle and R. Corkish Univ. of New South Wales, Sydney, Australia
3 P1.14
Zinc-diffused InAsSbP/InAs and Ge TPV Cells
V.P. Khvostikov, O.A. Khvostikova, E.V. Oliva, V.D. Rumyantsev, M.Z. Shvarts, T. Tabarov, V.M. Andreev, Russian Academy of Science, Ioffe Physico- Technical Institute, St. Petersburg, Russia
3 P1.15
Design Considerations for the Development of a Highly Reliable, Densely Packed Silicon Photovoltaic Array for TPV Applications
R. Gordon, K. Stone, and A. Slade, Amonix, Inc., Torrance, GA
3 P1.16
Investigations of a GaSb/GaAs TPV Device
Q. Fan, S. K. Haywood, Department of Engineering, Univ. of Hull, Hull, UK; G. Conibeer and C. Bumby, Glarendon Laboratory, University of Oxford, Oxford, UK

Wednesday, May 22, 2002
Poster Session 3P2
Regency F 15:35 ・17:30
Space Systems and Radiation Effects
Chairs: J. Fodor and C. Mayberry
3 P2.1
Development of Flex Circuit Wiring Harness for the Power Sphere Concept
E.J. Simburger, J. Matsumoto, T.W. Giants and J. Ross, The Aerospace Corp., Los Angeles, CA; S. Rawal, A. Perry, and C. Marshall, Lockheed Martin Space Systems, Denver, CO; D.M. Barnett, Consumers Power Corp., Inc.; J. Lin and C. Knoll, ILC Dover, Inc.; H. Curtis, T. Peterson and T. Kerslake, NASA Glenn Research Center, Cleveland, OH
3 P2.2
Electricity from Concentrated Solar in Solar IR Lighting Applications
L. M. Fraas, J. E. Avery, JX Crystals, Issaquah, WA
3 P2.3
Investigation of Transport Mechanism in Silicon Solar Cells After the Exploitation in Space
B.G. Budaguan, A.A. Sherchenkov, A.V. Sizov, , Moscow Institute of Electronic Technology (MIET), Russia; AB. Grabov, RSC 摘 nergia・Moscow, Russia
3 P2.4
A New Thin-Film Space PV Module Technology
L.B. Fabick, A. Yehle, S. Scott, B. Crume, G. Jensen, J. Armstrong, ITN Energy Systems, Littleton, CO
3 P2.5
Effect of Proton Irradiation and Subsequent Thermal Annealing on the Characteristics of Thin-Film Silicon Solar Cells and Microcrystalline Silicon Layers
J. Kuendig and A. Shah, Institute of Microtechnology, Univ. of Newchatel, Switzerland
3 P2.6
In-Situ Measurement of Degradation of Cu(In,Ga)Se2 Thin Film Solar Cells During Electron and Proton Irradiations
S. Kawakita, M. Imaizumi, and S. Matsuda, NASDA Tsukuba Space Center, Ibaraki, Japan; T. Ohshima, Japan Atomic Energy Research Institute, Japan
3 P2.7
High Energy Irradiation Properties of CdTe Solar Cells for Space Application
D. L. Batzner, A. Romero, H. Zogg, A. N. Tiwari, ETH, Zurich, Switzerland
3 P2.8
Measured and Simulated Dark J-V Characteristics of a-Si:H Single Junction p-i-n Solar Cells Irradiated with 40keV Electrons
K. Lord, J. R. Woodyard, Wayne State University, Detroit, MI
3 P2.9
Radiation Effects on High-Efficiency InGaP/InGaAs/Ge Triple Junction Solar Cells Developed for Terrestrial Use
M. Imaizumi, S. Matsuda, NASDA Tsukuba Space Center, Ibaraki, Japan; T. Takamoto, Sharp Corp., Nara, Japan; T. Ohshima, Japan Atomic Energy Research Institute, Gumma, Japan; M. Yamaguchi, Toyota Technical Institute, Nagoya, Japan
3 P2.10
Radiation Hard and Gravimetric Efficient Thin Film InP Solar Cells
Y. Sun, J. Woodall, Yale University, New Haven, CT; J.L. Freeouf, Oregon Health & Science University, Beaverton, OR; and R. J. Walters, Naval Research Laboratory, Washington, DC
3 P2.11
Radiation Damage Studies with 10MeV Protons on Silicon Solar Cells Using a Tandem Accelerator
M. Alurralde, M.J.L. Tamasi, C.J. Bruno, M.G.M. Bogado, J.C Pla, and J.F. Vazquez, Centro Atomico Constituyentes-CNEA, Provincia de Buenos Aires, Argentina
3 P2.12
Some Issues for Calculating Radiation Damage to Solar Cells
T.L. Morton, OAI/NASA Glenn Research Center, Cleveland, OH; S.R. Messenger, SFA, Inc., Largo, MD; R.J. Walters, Naval Research Laboratory, Washington, DC
3 P2.13
Space Degradation of Multijunction Cells: Analysis and Modelisation
M. Zazoui, Laboratoire, de Physique de la Matiere Condensee, F.S.T.M., Universite HassanII-Mohammedia, Moroc; A.Z. Aldin, Universite Tishrine, Departement de Physique, Lattaquie, Sryie; M. Mbarki, Universite de Gabes, Tunisia; and J.C. Bourgoin, Laboratoire des Milieux Desordonnes et Heterogenes, University Pierre et Marie Curie, Paris, France
3 P2.14
High Specific Power Amorphous Silicon Alloy Photovoltaic Modules
K.J. Beernink, G. Pietka, D. Wolf, A. Banerjee, J. Yang, S. Guha, United Solar Systems Corp., Troy, MI; J. Noch, S.J. Jones, Energy Conversion Devics, Inc., Troy, MI
3 P2.15
Fundamental Understanding of the Role of the Radiation-Induced Defects in n+p InGaP Solar Cells
A. Khan, Ohio State University, Columbus, OH; M. Yamaguchi, Toyota Technical Institute, Nagoya, Japan; J.C. Bourgoin, University Pierre et Marie Curie, CNRS, Paris, France; T. Takamoto, Japan Energy Corp., Japan

Wednesday, May 22, 2002
Poster Session 3P3
Regency F 10:10 ・12:00
Advanced and Novel High Efficiency Concepts
Chairs: D. Friedman and A Bett
3 P3.1
Long Term Reliability of Mass Produced High-Efficiency Silicon Point-Contact Solar Cells Under 250x Concentration

A. Slade, R. Gordon, V. Garboushian, Amonix Inc., Torrance, CA

3 P3.2

High Voltage Silicon Solar Cells for up to 1000 Suns Intensity

B.L. Sater, N. D. Sater, PhotoVolt, Inc., Strongsville, OH

3 P3.3

Deep-level Transient Spectroscopy in InGaAsN Lattice-Matched to GaAs

S.W. Johnston, R. K. Ahrenkiel, D. J. Friedman, and S. R. Kurtz, NREL, Golden, CO

3 P3.4

Development of a High Efficiency Metamorphic Triple-Junction 2.1 eV/1.6 eV/1.2 eV AlGalnP/InGaAsP/InGaAs Space Solar Cell

M.O. Patton, S. Sinharoy, V.G. Weizer, Essential Research Inc, Cleveland, OH

3 P3.5

Effect of Growth Paramenters and Hydrogenation on MOVPE Grown GaAs/Ge Solar Cells

R. Tyagi, T. Haldar, M. Bal, M. Singh, S. Mohan, S. K. Agarwal, V. Kumar, Solid State Physics Lab, Timapur, Dehli, India

3 P3.6

Control of Dark Currents in Multi-Quantum Well Solar Cells by Use of Thin Tunnel Barriers

Y. Okada, T. Takeda, M. Kawabe, University of Tsukuba, Japan

3 P3.7

Light Trapping Structures for Multi-Quantum Well Solar Cells

D.B. Bushnell, K.W.J. Barnham, J.P. Connolly, N.J. Ekins-Daukes, R. Airey, G. Hill, and J.S. Roberts, Experimental Solid State Physics, Blackett Laboratory, Imperial College of Science, Technology and Medicine, London, UK

3 P3.8

Four Junction Mechanical Stacked Concentrator Cell Approaching 40% (AMO)

C. Chu, P. Iles, and F. Ho, TECSTAR/ASD, City of Industry, CA; J. H. Atwater, and J.H. Zahler, Caltech, Pasadena, CA; M. Wanlass, NREL, Golden, CO; and P. George, NASA Glenn Research Center, Cleveland, OH

3 P3.9

Wafer Bonded Ge/Si Substrates for Triple Junction Solar Cell Structures

J.M. Zahler, C.G. Ahn, H.A. Atwater, Thomas J. Watson Lab. of Applied Physics, California Institute of Technology, Pasadena, CA; C. Chu and P. Iles, TECSTAR/ASD, City of Industry, CA

3 P3.10

Impact of Threading Dislocations on both n/p and p/n Single Juncton GaAs Cells Grown on Ge/SiGe/Si Substrates

C.L. Andre, A. Khan, M. Gonzalez, and M. K. Hudait, Amberwave Systems Corp, Salem, MA; E.A. Fitzgerald, MIT, Cambridge, MA; J.A. Carlin, and S.A. Ringel, Ohio State University, Columbus, OH

3 P3.12

A New Approach Based on the MSEO Model to Determining the Refractive Index of Multiple Quantum Wells; with the Presence of an Electric Field Perpendicular to the Well Layers as an Aid to QWSC Design

F.K. Rault, A. Zahedi, Monash University, Victoria, Australia

3 P3.13

Detailed Balance Efficiency of a Three Level System With Thermionic Transitions

S. Bremner, C. B. Honsberg, Centre for Photovoltaic Engineering, University NSW, Australia

3 P3.14

Multi-Stacked Quantum Dots with Graded Dot Sizes for PV Applications

S. Kanjanachuchai, S. Kumprachum, S. Kiravittaya, R. Songmuang, S. Thainoi, S. Kanjanachuchai, M. Sawadsaringkarn, and S. Panyakeow, Semiconductor Device Research Laboratory, Chulalongkorn University, Bangkok, Thailand

3 P3.15

A Comparative Study of Bulk InGaAs and InGaAs/InGaAs Strain-Compensated Quantum Well Cells for Thermophotovoltaic Applications

P. Abbott, C. Rohr, J.P. Connolly, I. Ballard, and K.W.J. Barnham, Experimental Solid State Physics, Imperial College of Science, London, UK; R. Ginige, and B. Corbett, Imperial College of Science, Technology and Medicine, London, UK; G. Clarke, and S.W. Bland, IQE (Europe) Ltd., Cardiff, Wales, UK; and M. Mazzer, IME-CNR, University of Lecce, Italy

3 P3.16

Enabling Technologies for Making GaAs-Based Thin-Film Solar Cells on Ceramic and Polysilicon Substrates

M. G. Mauk, J. Balliet, B. W. Feyock, AstroPower, Inc., Solar Park, Newark, DE

3 P3.17

Properties of Polycrystalline GaAs Films Grown on CMG Coverglass for Space Solar Cell Application

K. Ogayu, M. Imaizumi, T. Sogo, T. Jimbo, M. Umeno, Nagoya Institute of Technology, Nagoya, Japan

Wednesday, May 22, 2002

Poster Session 4P1 Regency H 10:10 • 12:00

Amorphous Si Materials, Devices and Processing

Chairs: X. Deng and B. Nelson

4 P1.1

Problems of Power Feeding in Large Area and Wafer Fabrication PECVD Systems

J. Kuske, U. Stephan, FAP, Dresden, Germany

4 P1.3

Effects of Strain on the Performance of Amorphous Silicon Triple-Junction Solar Cells

R. Jones, T. Johnson, W. Jordan, and S. Wagner, Princeton University., Princeton, NJ; J. Yang and S. Guha, United Solar Systems Corp., Troy, MI

4 P1.4

The Dynamic Inner Collection Efficiency in Solar Cells Calculated on the Basis of an Electrical-Optical Model

P. Chatterjee. Indian Assoc. for the Cultivation of Science, Kolkata, India; P. R. i Cabarrocas and R. Vanderhaghan, Ecole Polytechnique, Palaiseau, France

4 P1.5

The Influence of the Optical Bandgap of Buffer Layers at the p/I- and i/n-side on the Performance of Amorphous Silicon Germanium Solar Cells

D. Lundszein, F. Finger, Institute of Photovoltaics, Julich, Germany

4 P1.6

Wide-Gap Thin Film SI N-I-P Solar Cell Deposited by Hot Wire CVD

Q. Wang, E. Iwaniczko, NREL, Golden, CO; J. Yang, K. Lord, S. Guha, United Solar Systems Corp., Troy, MI; K. Wang, University of North Carolina at Chapel Hill, NC

4 P1.7

Optimization of p-a-SiC:H/p-nc-SiC:H Double Layer Structure for a High Efficiency a-Si:H Solar Cell

S. Y. Myong, S. S. Kim, K. S. Lim, KAIST, Daejeon, Republic of Korea; M. Konagai, TIT, Tokyo, Japan

4 P1.8

Effect of Buffer Layers on p-I-n a-Si:H Solar Cells Deposited at High Rate Utilizing an Expanding Thermal Plasma

B. A. Korevaar, A.M.H.N. Petit, C. Smit, and R.A.C.M.M. van Swaaij, Delft University of Technology, DIMES, The Netherlands; M.C.M. van de Sanden, Eindhoven University of Technology, Eindhoven, The Netherlands

4 P1.9

AMPS Modeling of Nanocrystalline Si p-Layer in a-Si NIP Solar Cells

X. B. Liao, W. Wang, X. Deng, University of Toledo, Toledo, OH

4 P1.10

Development of New Type of Encapsulant for Amorphous Silicon Solar Modules

A.K. Barua, Indian Assoc. for the Cultivation of Science, Jadavpur, India

4 P1.11

Investigation on the Interface of the Amorphous/Crystalline Silicon Solar Cell, a Simulation Study

A. Froitzheim, R. Stangl, L. Elstner, M. Schmidt, and W. Fuhs, Hahn-Meitner-Institute, Berlin, Germany

4 P1.12

Modeling Spectral Irradiation Effects on Single and Multi-junction Amorphous Silicon Photovoltaic Devices

T.R. Betts, R. Gottschlag, D. G. Infield, Centre for Renewable Energy Systems Technology, Loughborough University, UK

Wednesday, May 22, 2002

Poster Session 4P2 Regency H 15:35 ・17:30

Microcrystalline Si and Optical Enhancement

Chairs: S. Hegedus and K. Yamamoto

4 P2.1

Physical Properties of Microcrystalline Silicon Thin Films

H.R. Moutinho, H. Mahan, K. M. Jones, M.J. Romero, M.M. Al-Jassim, NREL, Golden, CO

4 P2.2

Characteristics of Intrinsic Protocrystalline Silicon Films Prepared by Photo-CVD Method

J. Ahn, K.H. Jun, and K.S. Lim, KAIST, Republic of Korea; and M. Konagai, TIT, Tokyo, Japan

4 P2.3

Electronic Structure and Doping p-type Transparent Conducting Oxides

S. Wei, X. Nie, S. B. Zhang, NREL, Golden, CO

4 P2.4

Deposition of Device Quality mc-Si:H Films by Hot-Wire CVD for Solar Cell Applications

J.C. Lee, K.H. Kang, S.K. Kim, K.H. Yoon, J. Song, and I.J. Park, Korea Institute of Energy Research, Taejon, Korea; S.W. Kwon and K.S. Lim, Korea Advanced Institute of Science and Technology, Taejon, Korea

4 P2.5

Investigation on the Role of Oxygen inオc-Si:H Thin Film and Its Deposition Process with VHF-PECVD

Y. Huidong, W. Chunya, M. Yaohua, G. Xinhua, Xiongshaozhen, Nankai University, Tianjin, P.R. of China; W. Hao, Wuyi University, Guangdong, China

4 P2.6

Influence of Film Thickness on Structural Properties of Microcrystalline Silicon Films

Y. Yoshioka, Y. Matsuyama, K. Kamisako, Tokyo University of Agriculture and Technology, Tokyo, Japan

4 P2.7

Substrate Dependence of Crystallization Silicon Films Prepared by Hydrogen Radical CVD Method

K. Kimura, T. Shirasawa, N. Kobayashi, K. Kamisako, Tokyo University of Agriculture and Technology, Tokyo, Japan

4 P2.8

Characterization of Microcrystalline Silicon Thin-Film Solar Cells

T. Brammer, H. Stiebig, Institute for Photovoltaics, Forschungszentrum Julich, GmbH, Julich, Germany

4 P2.9

Room Temperature Photoluminescence Studies of a-Si-H/c-Si Heterodiodes in Open Circuit, Short Circuit, and Maximum Power Point Operation

G.H. Bauer, R. Bruggeman, S. Tardon, T. Unold, FB Physics, CvO University, Oldenburg, Germany

4 P2.10

Al/ZnO(n+ or p+)/i-a-Si:H Junctions and Double-Side Antireflection Coatings as Components Improving Pin a-Si:H Solar Cells Performance

A. Kolodziej, P. Krewniak, S. Nowak, E. Leja, Krakow, Poland

4 P2.11

Transparent Conducting ZnO:Al Films via CCVD for Amorphous Silicon Solar Cells

Z. Zhao, M. Vinson, T. Neumuller,J.E. McEntyre, F. Fortunato, and A.T. Hunt, MicroCoating Technologies, Atlanta, GA; G. Ganguly, BP Solar, Toano, VA

4 P2.12

Direct Deposition of Textured ZnO:Al TCO Films by RF Sputtering Method for Thin Film Solar Cells

J.C. Lee, K.H. Kang, S.K. Kim, I.J. Park, J. Song, K.H. Yoon, Korea Institute of Energy Research, Taejon, Korea

4 P2.13

Deeply Etched Grating Structures for Enhanced Absorption in Thin c-Si Solar Cells

S. Zaidi, R. Marquardt, Gratings, Inc., Albuquerque, NM; B. Minhas, Univ. New Mexico; J. W. Tringe, AF Research Laboratory, Albuquerque, NM

Thursday, May 23, 2002

Poster Session 4P3

4 P3.1

Persistent Internal Photopolarization in C60 Thin Films: Proposal for a Novel Fullerene-Based Solar Cell

E.A Katz, D. Faiman and V. Lyubin, J. Blaustein Institute of Desert Research and Ben-Gurion University of the Negev, Israel

4 P3.2 Low-Temperature Growth of Polycrystalline Silicon Films Using SiCl4 and H2 Mixture

X. Lin, K. Lin, C. Huang, Y. Yu, C. Yu and R. Yao, Shantou University, Guangdong, Ching

4 P3.3 **Multicrystalline LLC-Silicon Thin Film Cells on Glass**

G. Andr J. Bergmann, E. Ose, N.D. Sinh, F. Falk, Institut fur Physikalische Hochtechnologie, e.V., Jena, Germany

4 P3.4 Thin Film Technology for Electron Beam Crystallized Silicon Solar Cells on Low Cost Substrates

J. Heemeier, M. Rostalsky, J. Mueller, Technical University of Hamburg-Harburg, Hamburg, Germany

4 P3.5 **Silicon Nanostructures by Metal Induced Growth (MIG) for Solar Cell Emitters**

C. Ji, E.A. Guliants, W.A. Anderson, University at Buffalo, State Univ. of New York, Buffalo, NY

4 P3.6 **Alternative Molecular Semiconductors for Sensitizing Nanocrystalline Solar Cells**

O. Chevaleevski, L.L. Larina, and K.S. Lim, KAIST University, Republic of Korea; A.A. Tsvetkov, Semenov Institute of Chemical Physics, Moscow, Russia

4 P3.7 **Current-Voltage Characteristics of Polymer-Fullerene Solar Cells**

I. I. Riedel, V. Dyakonov, J. Parisi, University of Oldenburg, Germany; L. Lutsen, D. Vanderzande, Institute for Materials Research, Diepenbeek, Belgium; J.C. Hummelen, Stratingh Institute and MSC, University of Groningen, The Netherlands

4 P3.8 **Direct Write Processing for Photovoltaic Cells**

T. Rivkin, C. Curtis, A. Miedaner, J. Perkins, J. Alleman, and D. Ginley, NREL, Golden, CO

4 P3.9 Third Generation Photovoltaics: Comparative Evaluation of Advanced Solar Conversion Options

M.A. Green, Centre for Third Generation Photovoltaics, UNSW, Sydney, Australia

4 P3.10 **Shunt Analysis of Epitaxial Thin-Film Solar Cells by Lock-In Thermography**

S. Bau, J. Isenberg, D. Huljic, Fraunhofer Institute for Solar Energy Systems, Freiburg, Germany

4 P3.11 Grain Growth of Polycrystalline Si Thin Film for Solar Cells and Its Effect on Crystal Properties

T. Ujihara, E. Kanda, K. Fujiwara, G. Sazaki, N. Usami, Y. Murakami and K. Nakajima, Tohoku University, Sendai, Japan; K. Kitahara Shimane University, Matsue, Japan

4 P3.12 Dye Sensitized Porous Titanium Dioxide Thin Films with Merbromin and Rose Bengal

L. Roy, Photovoltaic Laborator, Centre for Energy Studies, Indian Institute of Technology, Delhi, India; L. Bahadur, Banaras Hindu University, Varanasi, India

4 P3.13 **DOE/NREL Sponsored Research in Novel Solar Electric Technologies**

R. Matson, R. McConnell, NREL, Golden, CO

Tuesday, May 21, 2002

Poster Session 5P1

Regency G 15:40 ・17:40

Systems Components

Chairs: M. Quintana and R. Hudson

5 P1.1

Monitoring Current Voltage Characteristics of Photovoltaic Modules

E.E. van Dyk, A.R. Gxasheka, and E.L. Meyer,University of Port Elizabeth, Port Elizabeth, South Africa

5 P1.2

Backside Solutions

S. R. Cosentino, DuPont Teijin Films, Hopewell, VA; S.B. Levy, Clear Solutions, Wilmington, DE; and R. Tucker, Specialized Technology Resources, Inc., Enfield, CT

5 P1.3

Comparison of Energy Production and Performance From Flat Plate Photovoltaic Module Technologies Deployed at Fixed Tilt

J. A. del Cueto, NREL, Golden, CO

5 P1.4

Measurements of PV Module Performance Under Various Environmental Conditions

D. Thevenard, Numerical Logics, Inc., Vancouver, BC Canada; P. Cusack, ARISE Technologies, Corp., Kitchener, ON, Canada

5 P1.5

Photovoltaic Grid-Connected Inverter Using Two Switch Buck-Boost Converter

K. Chomsuwan, King Mongkut's University of Technology Thonburi; P. Prisuwanna, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand; and V. Monyakul, National Science and Technology Development Agency, Thailand

5 P1.6

A Novel Two-Mode MPPT Control Algorithm Based on Comparative Study of Existing Algorithms

G. J. Yu, Y. S. Jung, K. H. Kim, , Korea Institute of Energy Research, Taejon, KoreaJ. Y. Choi, Kwangwoon Univ., Seoul, Korea

5 P1.7

Novel PV Array/Module I-V Curve Simulator Circuit

H. Nagayoshi, S. Orio, Y. Kono, H. Nakajima, Shonan Institute of Technology, Kanagawa, Japan

5 P1.8

Integrated Bypass Battery for Reverse Bias Protection

G. Landis, NASA Glenn Research Center, Cleveland, OH

5 P1.9

Degradation Analysis of Weathered Crystalline-Silicon PV Modules

C.R. Osterwald, T. J. McMahon, NREL, Golden, CO

5 P1.10

New Barrier Coating Materials for PV Module Backsheets

G. D. Barber, G. J. Jorgensen, K. Terwilliger, T. J. McMahon, NREL, Golden, CO

5 P1.11

The Development of a Scaled Down Simulator for Distribution Grids and Its Application for Verifying Interference Behavior Among a Number of Module Integrated Converters (MIC)

Y. Noda, T. Mizuno, H. Koizumi, K. Nagasaka, and K. Kurokawa, Tokyo University of Agriculture and Technology, Tokyo, Japan

5 P1.12

Applications and Field Tests of Bifacial Solar Modules

T. Johge, Y. Eguchi, I. Araki, and T. Uematsu, Hitachi, Ltd., Japan; and K. Matsukuma, Sojo Univ., Kumamoto, Japan

5 P1.13

Thermophotovoltaics: Heat and Electric Power from Low Bandgap 鉄 olar・Cells Around Gas Fired Radiant Tube Burners

L.M. Fraas, J.E. Avery and H.X. Huang, JX Crystals, Issaquah, WA

5 P1.14

Loss Factors Affecting Power Generation Efficiency of a PV Module

R. Suzuki, H. Kawamura, S. Yamanaka, H. Kawamura, H. Ohno, K. Naito, Meijo University, Nagoya-city, Japan

5 P1.15

The Economics of Solar Powered Refrigeration Transport Applications

A.S. Bahaj and P.A.B. James, Sustainable Energy Research Group, University of Southampton, Southampton, UK

5 P1.16

Accelerated Testing of an Encapsulant For PV Modules

J. I. Hanoka, Evergreen Solar, Inc., Marlboro, MA

Wednesday, May 22, 2002

Poster Session 5P2 Regency G 15:35 ・17:30

Concentrator Systems

Chairs: R. McConnell and D. Faiman

5 P2.1

A Simple Passive Cooling Structure and Its Heat Analysis for 500X Concentrator PV Module

K. Araki, H. Uozumi, Daido Steel Co., Ltd., Nagoya, Japan; M. Yamaguchi, Toyota Technological Institute, Nagoya, Japan

5 P2.2

Development of a Metal Homogenizer for Concentrator Monolithic MJ-Cells

K. Araki, M. Kondo, and T. Kashiwagi, Daido Steel Co., Ltd., Nagoya, JapanR. Leutz, and A. Akisawa, Tokyo University of Agriculture and Technology, BASE, Japan; M. Yamaguchi, Toyota Technological Institute, Nagoya, Japan

5 P2.3

Testing of Photovoltaic Concentrator Modules

E.E. van Dyk, and A.W.R. Leitch, University of Port Elizabeth, South Africa; F.J. Vorster, Port Elizabeth Technikon, South Africa

5 P2.4

Progress in the Manufacture of Ultra Flat Optics for Very High Concentration Flat Panels

V. Diaz, and J. Alonzo, ISOFOTON S.A.Malaga, Spain; M. Hernandez, J.L. Alvarez, M. Labrador, J. Blen, R. Mohedano,

P. Benitez, and J.C. Minano, Instituto de Energia Solar, Univeridad Politecnica de Madrid, Spain; W. Preuss, A. Gessenharter, Univ. of Bremen, Bremen, Spain

5 P2.5

A New Static Concentrator PV Module with Bifacial Cells for Integration on Facades: The PV Venetian Store

J. Alonzo and V. Diaz, ISOFOTON S.A.Malaga, Spain; M. Hernandez, F. Bercero, C. Canizo, I. Pou, R. Mohedano, P. Benitez, J.C. Minano, and A. Luque, Instituto de Energia Solar, E.T.S.I.T. Ciudad Universitaria s/n, Madrid, SpainS. Steckemetz, A. Metz, and R. Hezel, Institut fur Solareenergieforschung, Germany,; J.C. Jimeno, R. Gutierrez, F. Recart, G. Bueno, V. Rodriguez, and F. Hernando, Instituto de Tecnologia Microelectonica, Spain; V.M. Sukhostavets, and S. Beringov, JSC PILLAR, Ukraine; K. Sassoli,C. Iachetti, and G. Caroti, EUROINKS, Italy

5 P2.6

Optical Filtering of Solar Radiation to Increase Performance of Concentrator Systems

M. Sabry, and M.A.M. Shaltout, Solar Physics Laboratory, National Research Institute of Astronomy and Geophysics, Egypt; A.F. Hassan, and M.M. El-Nicklawy, Helwan Univ., Egypt; R. Gottschalg, T.R. Betts, and D.G. Infield, Centre for Renewable Energy Systems Technology, Loughborough University, UK

5 P2.7

Interaction Between Sun Tracking Deviations and Inverter MPP Strategy in Concentrators Connected to Grid

I. Anton, G. Sala, Instituto de Energie Solar, Universitad Politecnica de Madrid, Spain; J. Monedero, F. Perez, P. Valera, M. P. Friend, M. Cendagorta, ITER; I. Luque, INSPIRA

5 P2.8

Terrestrial and Space Concentrator PV Modules with Composite (Glass-Silicone) Fresnel Lenses

V.D. Rumyantsev, V.A. Grilikhes, N.A. Sadchikov, M.Z. Shvarts, V.M. Andreev, Ioffe-Physico-Technical Institute, St. Petersburg, Russia; O.I. Chosta, A.A. Soluyanov, Scientific-Production Association “SOLEN”, St. Petersburg, Russia

5 P2.9

Rating and Modeling of Concentrator Systems

D. Pachon, I. Anton, and G.Sala, Instituto de Energia Solar, ETSI Telecommunicacion, Madrid, Spain

5 P2.10

Investigation on the I-V Characteristics of a High Concentration, Photovoltaic Array

F.J. Vorster, Port Elizabeth Technikon, South Africa; E.E. van Dyk, and A.W.R. Leitch, University of Port Elizabeth, South Africa

5 P2.11

Solar Electric Concentrators with Small Concentration Ratios: Field Experience and New Developments

H.D. Mohring, and H. Gabler, Zentrum fuer Sonnenenergie und Wasserstoff-Forschung, Baaden-Wuerttemberg (ZSW), Stuttgart, Germany

5 P2.12

High Concentration Tests of Multijunction PV Cells

R. Sherif, A. Paredes, H. Cotal, G. Glenn, D. Krut, T. Meza, Spectrolab, Inc. Sylmar, CA; H. Hayden, Arizona Public Service, Phoenix, AZ

5 P2.14

Dish/Photovoltaic Cavity Converter (PVCC) System for Ultimate Solar-to-Electricity Conversion Efficiency General Concept and First Performance Predictions

U. Ortabasi, United Innovations, Inc., San Marcos, CA;A. Lewandowski, R. McConnell, NREL, Golden, CO;D.J. Aiken, and P.L. Sharps, EMCORE PhotoVoltaics, Albuquerque, NM; B.G. Bovard, Rockwell Scientific, Thousand Oaks, CA

5 P2.15

Development of Terrestrial Static PV Concentrator Modules Incorporating BiFacial Solar Cells

D. Strebkov, E. Tveryanovich, I. Tyukhov, A. Irodionov, The All-Russian Research Institute for Electrification of Agriculture, Moscow, Russia

Thursday, May 23, 2002

Poster Session 5P3 Regency G 16:00 ・17:45

PV Systems

Chairs: S. Ransome

5 P3.1

Performance Analysis of a PV Array Installed on Building Walls in a Snowy Country

K. Yoshioka, J. Hasagawa, T. Saitoh, Tokyo A&T Univ., Tokyo, Japan; S. Yatabe, Shirouma Science Co., Ltd., Toyama, Japan

5 P3.2

First Results of the Brazilian Experience with a Photovoltaic Powered Reverse Osmosis Plant

P. Carvalho, DEE-UFC, Brazil; C. Freire, ARCE, Brazil; F. Montenegro, CEFET, Brazil

5 P3.3

Grid-Interfaced Urban SPV Power Packs

H. Saha, A. Mondal, IC Design and Fabrication Centre, Jadavpur University, Kolkata, India; A. Mahato, K. Mukhopadhyay, Agni Power and Electronics Pvt., Ltd., Kolkata, India

5 P3.4

A Study of the Automatic Analysis for the I-V Characteristics of a Photovoltaic Subarray

T. Mishina, H. Kawamura, S. Yamanaka, H. Kawamura, H. Ohno, K. Naito, Meijo Univ., Nagoya, Japan

5 P3.5

Peak Load Shaving in Conventional Electrical Grids by Small Photovoltaic Systems in Sunny Regions

E. Ortjohann, and O. Omari, University Paderborn/Abteilung Soest, Germany

5 P3.6

PV System Integrated Evaluation Software

P.S. Pimentel, T. Oozeki, T. Tomori, K. Kurokawa, Tokyo University of Agriculture and Technology, Tokyo, Japan; H. Matsukawa, Resources Total system Co., Ltd., Tokyo, Japan

5 P3.7

Evaluating Building Integrated Photovoltaic Performance Models

M.W. Davis, A.H. Fanney, and B.P. Dougherty, National Institute of Standards and Technology, Gaithersburg, MD

5 P3.8

Hybrid Standalone Power Plant Having Power 2kW Based on Solar Panel and Thermoelectric Generator

M.B. Kagan, V P. Nadorov, V.M. Rzhevski, B.V. Sporyshev, V.A. Unishkov, SPRE 適 VANT・Moscow, Russia

5 P3.9

Grid Connected PV System Using Two Energy Processing Stages

D.D. Martins and R. Demonti; Federal University of Santa Catarina, Brazil

5 P3.10

Photovoltaic Cell Characteristics for High-intensity Laser Light in Fiber Optic Power Transmission Systems

H. Miyakawa, R. Hyodo, Y. Tanaka, T. Kurokawa, Tokyo University of Agriculture and Technology, Tokyo, Japan

5 P3.11

Modeling and Simulation of Photovoltaic Hybrid Energy Systems—Optimization of Sizing and Control

W. Schmitt, Ecole Superieure d脱lectricite Service EEI, Yvette, France

5 P3.12

LED Lighting and PV Systems

M. Brown, Sandia National Laboratories, Albuquerque, NM

5 P3.13

Development of High Efficiency Hybrid PV-Thermal Modules

D.L. Staebler, Terrasolar, Brooklyn, NY; N.B. Urli, Rudjer Boskovic Institute, Coatia; Z.J. Kiss, Princeton, NJ

5 P3.14

Operating Experiences with PV in a Distributed Energy Resources Microgrid

J.W. Ginn, M. E. Ralph, S. Gonzalez, Sandia National Laboratories, Albuquerque, NM

5 P3.15

Performance Analysis of Portable PV Systems Based on Measured Data in Mongolia

A. Adiyabat, K. Kurokawa, Tokyo University of Agriculture and Technology, Tokyo, Japan

5 P3.16

All-In-One Solar Home System

S. Krauter, F. Ochs, Laboratorio Fotovoltaico, Rio de Janeiro, Brazil

5 P3.17

A Cost Analysis of Very Large Scale PV (VLS-PV) Systems on the World Deserts

K. Kurokawa, M. Ito, Tokyo University of Agriculture and Technology, Tokyo, Japan; K. Kato, New Energy and Industrial Te chnology Development Organization, Japan; K. Komoto, Fuji Research Institute Corp., Japan; T. Kichimi, Resource Total System Co., Ltd., Japan; H. Sugihara, Kandenko Co., Ltd.

5 P3.19

Sun Power Electric ・A Solar Utility

J. Hoffner, S. Cowell, J. Pichumani, D. Porrazzo, S. Wiese, J. Wylde, Conservation Services Group, Austin, TX

Friday, May 24, 2002

Poster Session 5P4 Regency GH 13:30 ・15:15

Field Experience

Chairs: B. T. Didier and J. Wohlgemuth

5 P4.1

Application of Photovoltaic Electro-Chlorination Process

K. Khouzam, Queensland University of Technology, Brisbane, Australia

5 P4.2

Comparison of the Performance of Residential Photovoltaic Power Systems in New Home Construction

R. Stephenson, E. Palomino, SRP, Phoenix, AZ; T. Lepley, Phasor Energy Co., Phoenix, AZ

5 P4.3

Terrestrial Solar Spectral Modeling Tools and Applications for Photovoltaic Devices

D. Myers, K. Emery, NREL, Golden, CO; C. Gueymard, Consultant, Bailey, CO

5 P4.4

Making the Arizona Sun a Little Brighter

T. Hansen, Tucson Electric Power, Tucson, AZ

5 P4.5

A Feasibility Study on Renewable Energy Systems for Island Electrification in Thailand

W. Tayati, Chiang Mai University, Thailand; N. Lowattanatakul, Provincial Electricity Authority, Bangkok, Thailand; G. Thompson, International Centre for Application of Solar Energy, Perth, Australia

5 P4.6

Life-Cycle Costs in Livestock Water Pumping - A Rural Electric Co-op 痴 Experience

L. Moore, L. Malczynski, Sandia National Laboratories, Albuquerque, NM; R. Skinner, Northwest Rural Public Power District, Hay Spring, NE

5 P4.7

First Year Solar Home Systems Performance Monitoring in Indonesia

A.S. Dasuki, M. Djamin, The Agency for Assessment and Application of Technology (BPPT), Jakarta, Indonesia; F. Nieuwenhout, Netherlands Energy Research Foundation (ECN), The Netherlands

5 P4.8

Field Test Results on the Stability of 2,400 Photovoltaic Modules Manufactured in 1990 痴

Y. Hishikawa, National Institute of Advanced Industrial Science and Technology, Ibaraki, Japan; K. Morita, Japan Electrical Safety & Environment Technology Laboratories, Tokyo, Japan; T. Oshiro, Japan Quality Assurance Organization, Shizuoka, Japan

5 P4.9

First Year Performance for Roof-mounted, 45-kW PV Array on Oberlin College 痴 Adams Joseph Lewis Center

J.H. Scofield, Oberlin College, OH

5 P4.10

The Performance of Fully Monitored, Double-Junction a-Si Grid-Connected BIPV System after Four Years of Continuous Operation in Brazil

R. Ruther1,2, M.M. Dacoregio2, and A.A. Montenegro2, 1LABEEE, Brazil, 2LABSOLAR, Florianopolis, Brazil

5 P4.11

Performance of Amorphous Silicon Double Junction Photovoltaic Systems in Different Climatic Zones

R. Gottschalg, T.R. Betts, D.G. Infield, and M..J. Kearney, Centre for Renewable Energy Systems Technology (CREST), Loughborough, UK; C.N. Jardine, G.J. Conibeer and K. Lane, Environmental Change Institute, University of Oxford, Oxford, UK; J. Close and K.H. Lam, The University of Hong Kong, China; R. Ruther, LABSOLAR, Florianopolis, Brazil; R. Tscharner, Institut de Microtechnique, Neuchatel, France

5 P4.12

A Review of Field Performance of EVA-based Encapsulants

R.T. Tucker, R.S. Yorgensen, Specialized Technology Resources, Enfield, CT

5 P4.13

Solar Schools ・Experiences with Different Programs

J. Hoffner, S. Wiese, J. Pichumani, Conservation Services Group, Austin, TX

5 P4.14

Recent Application and Performance of Large, Grid-Connected Commercial PV Systems

G. Ball, PowerLight Corp., Berkeley, CA; R.M. Hudson, M.R. Behnke, Xantrex Technologies Inc., Livermore, CA

5 P4.15

Satellite Monitoring of Remote PV-Systems

S. Kraufer, F. Ochs, T. Depping, Laboratorio Fotovoltaico, UFRJ-COPPE-EERio de Janeiro, Brazil

5 P4.16

The Status of PV Technology and Market in Nigeria

M.A.C. Chendo, University of Lagos, Nigeria

5 P4.17

Progress in PV Technology Development under the New Sunshine Program JFY 1997-2000 ・PV System Technology

K. Kato, Y. Nobue, T. Yokoda, F. Hayashi, M. Yamada, K. Yamada, K. Shino, K. Ogawa, Solar and Wind Energy Department, NEDO, Tokyo, Japan

5 P4.18

Progress in PV Technology Development under the New Sunshine Program JFY 1997 ・2000 ・Solar Cell Manufacturing Technology

F. Aratami, S. Kuriyagawa, S. Kato, S. Sakai, F. Hayashi, T. Nishimura, K. Shino, K. Ogawa, Solar and Wind Energy Department, NEDO, Tokyo, Japan

5 P4.19

Cost and Performance Results From More Than 600 Residential Installations

J. Schaefer, Clean Power Works, Arcata, CA

5 P4.20

Spectral Corrections Based on Optical Air Mass

K. Emery, NREL, Golden, CO, and W. Zaaiman, European Commission Joint Reseach Centre, Ital

11　主な入手資料

Booth	Organization	Title
1	OCLI	Solar Cell Covers _ Radiation-Resistant, Improved Transmittance Glass
		Solar Cell Coverglass _ 0213 Radiation-Resistant Glass
		TRIED AND TRUE
2	HCT Shaping Systems SA	
3	AstroPower	Everything you need to GENERATE YOUR OWN ELECTRICITY at home
		Catalog (module)
		ANNUAL REPORT 2001
4	Q-cells AG	
5	GT Solar Technologies	
6	Photo Emissions Tech. Inc.	
7	Bekaert ECD Solar Systems LLC	
8	John Willy & Sons	
9	BP Solar	2002 Calendar
		Catalog (module)
10	Amonix Inc.	
11	Sandia National Laboratories	SANDIA REPORT _ Photovoltaic Power Systems and the National Erectrical Code: Suggested Practices
		SANDIA REPORT _ Status and Needs of Power Electronics for Photovoltaic Inverters: Summary Document
		Renew the Government _ Summary of Projects and Lessons Lerned
		Highlights of Sandia's Solar Programs (Vol.1-3)
		Power Where You Need It _ The Promise of Photovoltaics
		The SOLAR WAY
		SOLVING FOR THE UNKNOWN... JUST GOT EASIER
		Publication Order Form
12 & 45	National Center for Photovoltaics	SOLAR ELECTRICITY the power of choice
		THE DAWN OF A NEW ERA

13 & 14	Able Engineering	
15 & 16	Spectrolab, Inc.	
17	ITN Energy Systems, Inc.	Catalog (total equipment solutions: for thin film processing needs)
18	Global PV Specialists Inc.	
19	Optosolar GmbH	Flashlight Solar Simulator 2*2m2 L/T
20	Dupont Microcircuits Materials	
21	TRW	
22	STR - Specialized Technology Resources, Inc.	
23	Emcore Photovoltaics	Catalog (cell)
24 & 25	Astrium GmbH	
26	Spire Corp.	Catalog (sun simulator, laminator, assembler, array tester ...)
27 & 28	Pilkington Optronics	
29	Sinton Consulting Inc.	WCT-100 Silicon-Wafer Lifetime Tester
30	James & James	RENEWABLE ENERGY WORLD (July-Aug '01, Mar-Apr '02, May-June '02)
		SUSTAINABLE ARCHITECTURE
		RENEWABLE ENERGY
31 & 32	NPC Inc.	PV MODULE EQUIPMENT AND FULL-AUTO PRODUCTION LINE
		THE PRESS IN JAPAN
33	Isovolta AG	
34 & 35	Lockheed Martin Space Company	
36 & 37	AMI - Affilated Manufacturers Inc.	
38 &	Dutch Space	

39		
40 & 41	Radiant Technology Corp.	
42	COI - Composite Optics Inc.	
43	Ferro Electronic Material Systems	
44	PV Energy Systems	THE WORLD PHOTOVOLTAIC MARKET
		PHOTOVOLTAIC NEWS

others	NREL	Introduction to Photovoltaic System Applications and Design
		Disaster! Reduce the risk of Insurance Loss with Renewable Energy Technologies
		NREL International Programs
		Changing the Face of Energy
		PHOTOVOLTAICS Energy for the New Millennium _ The National 2000-2004 Photovoltaics Program Plan
		SOLAR ELECTRICITY _ the power of choice
		First International Conference on Solar Electric Concentrators
	ELSEVIER ADVANCED TECHNOLOGY	Photovoltaics Bulletin
		Fuel cells Bulletin
		REFOCUS _ THE INTERNATIONAL RENEWABLE ENERGY MAGAZINE
		ELECTRIC POWER SYSTEMS RESEARCH
		INTERNATIONAL JOURNAL OF ELECTRICAL POWER & ENERGY SYSTEMS
		ENERGY POLICY
	SUN POWER	Disaster! Reduce the risk of Insurance Loss with Renewable Energy Technologies
		Sun Profi Emergency _ PV Inverter Type E
	Thales Space Technlogy	CMX _ Conductive Coated Solar Cell Coverglasses
		CMZ _ Solar Cell Coverglasses
		CMG _ Solar Cell Coverglasses
	IEEE	Federal Legislative Agenda for the 107th Congress 2001-2002
		Committee on Communications & Information Policy _ Position Statements
	DOE Office of Solar Energy	Solar America _ A solar energy tour of the United States (CD-ROM)

Technologies	
	PHOTOVOLTAICS OVERVIEW FISCAL YEAR 2001
PV in europe	FINAL CALL FOR PAPERS _ PV IN EUROPE FROM PV TECHNOLOGY TO ENERGY SOLUTIONS
ZAE Bayern	THERMOSENSORICS
	RESEARCH DEVELOPMENT ANALYSIS, MATERIALS COMPONENTS SYSTEMS
PMC - POWER MARK	
CORPORATION	Photovoltaic Module and Component Certification Program
FERRO	Materials that work _ Photovoltaic Materials Systems
U.S. Department of Energy	SOLAR BUILDINGS
UNI-SOLAR	Catalog (solar lighting system, solar battery charger, solar electric module ...)
Loughborough University	Training and Education in Renewable Energy
	Annual Report 2001
WILEY	Progress in PHOTOVOLTAICS _ Research and Applications
PERGAMON	ENERGY CONVERSION & MANAGEMENT _ An International Journal
PANAMAC	COMPANY PROFILE
Resources Total System Co., Ltd.	PV Activities in Japan