

NCCAVS Joint User Group Topical Conference on “Photovoltaic Technology”

Hosted by:

- ❖ Junction Technology
- ❖ Plasma Applications
- ❖ Thin Films

Sponsored by:

[Applied Materials](#)
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In conjunction with:

- ❖ 32nd NCCAVS Equipment Exhibition
- ❖ First Annual Student Poster Exhibition

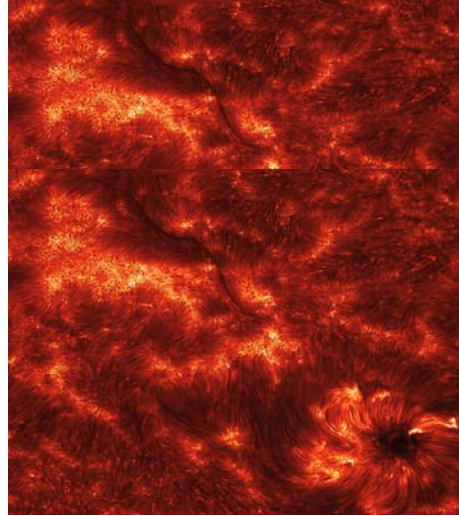
Wyndham San Jose Hotel

1350 N. First Street

San Jose, CA 95112

February 23, 2011

<http://www.avsgroups.org>



Conference Program

Session I, Plenary – Chair: Susan Felch

9:00 – 9:05 Opening Remarks

9:05 – 9:50 “A PV Industry Update – The State of the Industry”, Karen Savala, SEMI

Abstract:

Biography:

Karen Savala is president of SEMI Americas. Savala assumes responsibility for the association’s Americas programs, including events, products and services. She is responsible for relationships with SEMI members as well as industry, government and academia in the region. Savala joined SEMI in 1984 and has served in numerous managerial and executive roles, including positions in International Standards, executive programs, publishing, and outreach and membership. She established the “Voice of the Customer” program which helped drive product and service improvements to improve SEMI member satisfaction.

9:50 – 10:05 Coffee Break

Session II – Chairs: Kapila Wijekoon, Paul Werbaneth

10:05 – 10:35 “The evolving cell architecture: another look at the PV roadmap”, Michel Frei, Applied Materials

Abstract:

The current rapid pace of evolution in the photovoltaics market is accompanied by large investments in technology development and capital equipment. Several promising technology options are being developed in R&D laboratories around the world, and may be poised for wide-spread adoption in cell production lines. Whenever the technology change also requires a change in tool architecture or configuration, a careful

assessment has to be made about the true benefit of the technology change compared to those obtainable by improvement to existing processes and tools. The required predictive analysis has often been difficult, due to still imperfect models for materials and processes and the realities of implementation. To illustrate these challenges, we will discuss a variety of cases taken from both thin film and crystalline silicon technologies.

Biography:

Michel Frei heads the Cell Analysis group in the Solar division of Applied Materials. Previously, he was with Bell Laboratories in Murray Hill, NJ, where he developed technologies for III-V HBTs, SiGe BiCMOS, and Si RF LDMOS. He holds a Diploma from the Swiss Federal Institute of Technology in Lausanne, Switzerland, and a PhD in Electrical Engineering from Princeton University.

10:35 – 11:05 “Precision process power and controls for photovoltaic manufacturing”, Randy Heckman, Advanced Energy

Abstract:

Since 1981, AE has leveraged its competency in power conversion, measurement, and control to innovate advanced systems used in the manufacturing of semiconductors, flat panel displays, data storage, and industrial coatings. This experience has proven essential to provide the large variety of thin-film technologies required in the fabrication of both crystalline and thin-film solar cells. Deposition of front and back contact layers in thin-film solar cells require both DC and LF powered systems that reduce the build-up of charge that can create arcs, while also managing the arc energy when arcs occur. PECVD systems used in depositing amorphous silicon require high frequency power. Many of these systems used to manufacture tandem cells utilizing microcrystalline silicon have migrated to VHF power to increase process rates at lower energies in order to reduce the formation of defects. However, maintaining film uniformity in large area systems powered by VHF continues to be a significant challenge. And advanced anti-reflective coatings for crystalline silicon optimizes process power to reduce cost while increasing rate and cell efficiency. This presentation will highlight many of the advanced process power technologies used today in the fabrication of solar cells to increase precision, prevent defects, and improve throughput.

Biography

Randy L. Heckman joined Advanced Energy in October 1990 and is the Vice President of R&D and Engineering for AE's Thin Film Business Unit. Mr. Heckman brings 24 years of experience in power systems research and design, and is presently focused on leading R&D and development engineering for advanced power and control systems utilized in powered plasma processes. He started his career with Continental Electronics, a former division of Varian Associates, developing high power radar transmitters for military applications. Mr. Heckman holds a B.S. degree in Electrical Engineering from the University of Arkansas. He is an R&D 100 award winner, and holds several US and international patents, with others pending.

11:05 – 11:35 “The flip side of technology: how plasma systems must evolve for solar PV applications”, Andy Skumanich, SolarVision Co.

Abstract:

Typically in science and technology fields, the driving force is improvement of a given technical metric. This is particularly the case for semiconductors where Moore's Law (and the More Moore's law, etc.) dictates ever smaller dimensions and exotic materials. In solar PV manufacturing there is no Moore's law, and there cannot be, for a specific reason – cost. The cost of manufacturing is the flip side of technology in PV and both sides of the coins must be considered for any technical innovation. This talk will discuss the Technology Roadmap of PV and how process equipment such as plasma deposition tools need to evolve to address the specific requirements of PV. The contrast will be made with plasma deposition tools utilized in the semiconducting manufacturing environment. The key challenges for PV process equipment developments will be described and addressed.

Biography

Dr. Andy Skumanich is Founder and CEO at SolarVision Co. which is a boutique market research company offering both technical and business support in the solar domain since 2007, and which has now grown to include a team of seasoned industry experts. Previously, Andy was Vice President at Innovalight, a solar cell

company in Silicon Valley. He spent several years at Applied Materials in the Solar division, and prior to that in the AMAT Semiconductor division. He was an Engineering Manager at KLA. Before that, he was a Research Staff Member at IBM Research pursuing advanced thin film materials. He received his Ph.D. in Physics from Berkeley on thin films for photo-voltaics. He is a Hertz Foundation Fellow and a member of Phi Beta Kappa. He has published numerous scientific papers as well as technical solar papers, and has been asked to present at numerous solar conferences. He is broadly knowledgeable in the technical and market aspects of the PV Technology roadmap, along with Thin Film PV, CPV, CSP, and BIPV. More details can be found at www.solarvisionco.com

11:35 – 12:05 “Modeling and Optimization of Silicon Solar Cells”, Victor Moroz, Synopsys

Abstract:

The performance of a mono-crystalline silicon solar cell is determined by a variety of optical and electronic physical mechanisms. Optimization of cell performance requires finding trade-offs for the competing physical mechanisms. In this work we use three-dimensional optical analysis and electronic transport analysis to determine optimization space for a solar cell with textured surface and point rear contacts. Optimization of the surface texture, antireflective layers, contact size and pitch, and junctions can improve the overall solar cell efficiency by over 4%.

Biography

Victor Moroz received his Ph.D. in Semiconductor Physics in 1992 from the University of Nizhny Novgorod, Russia. His professional career revolves around semiconductor physics and includes silicon process integration in the industry, teaching undergraduate and graduate students, and for the last 15 years - developing physical models, numerical algorithms, and modeling methodologies for Technology CAD simulation tools at TMA, Avanti, and TCAD Department at Synopsys. Several facets of this activity are reflected in three book chapters and over 100 technical papers, invited presentations, and patents. Has been involved in technical committees at ITRS, IEDM, and ESSDERC.

12:05 – 1:30 Lunch Break

Session III, Plenary – Chair: Sing-Pin Tay

1:30 – 2:15 “PV Market Trends, Emerging Technologies and PV Economics”, Eric Wesoff, Greentech Media

Abstract:

This talk will cover some of the current market, policy and technological trends in the solar industry as well as look at the potential for energy storage to back up intermittent renewable energy sources such as solar PV and wind power.

Biography:

Prior to joining Greentech Media, Eric Wesoff founded Sage Marketing Partners in 2000 to provide sales and marketing-consulting services to venture-capital firms and their portfolio companies in the alternative energy and telecommunications sectors. Mr. Wesoff has become a well-known, respected authority and speaker in these fields. He also was the publisher of the Venture Power newsletter, a subscription-only newsletter covering venture-capital investment in renewable energy. Eric's expertise covers solar power, fuel cells, biofuels and advanced batteries. His strengths are in market research and analysis, business development and due diligence for investors. He frequently consults for energy startups and Silicon Valley's premier venture capitalists. From 1988 to 1996, Eric served as product marketing manager for Siemens Optoelectronics, where he oversaw complex product lines and managed relationships with global customers. He then became the U.S. marketing and sales manager for Akzo Nobel Photonics, which was acquired by JDS Uniphase. Eric later served as the sales director for Dicon Fiber Optics, where he was responsible for selling millions of dollars of fiber-optic telecom-equipment. He has consulted for Merck, JDSU, Coherent, IBM and scores of other firms, governments and organizations.

2:15 – 2:30 Coffee Break

Session IV – Chairs: Michael Current, Huey-Chiang Liou

2:30 – 3:00 “Trends in Photovoltaics”, Peter Borden, Jasper Ridge LLC

Abstract

Photovoltaics is on firm ground as a rapidly expanding renewable energy technology, with nearly 100% market growth in the past year. This talk discusses trends as the technology becomes more and more mainstream. The dynamic between efficiency and cost continues to be played out. Mainstream wafer-based silicon continues a rapid decline in cost as efficiencies rise. New process technologies are emerging, such as laser processing, ion implant, and silicon ink. Thin film continues to keep pace, with First Solar exceeding 11% efficiency at a cost under 80¢/watt. Finally, there is increased focus on balance of system, including trackers, micro-inverters, power optimizers, and storage.

Biography

Dr. Peter Borden is Managing Director of Jasper Ridge LLC, a company developing renewable energy products. Earlier, he was with Applied Materials' Solar Business Group from its inception, developing both thin film and wafer-based silicon technologies. He began his career at Varian Associates where, he led the Photovoltaics Group, developing III-V and silicon concentrator cells and systems. In this role, he and his group set performance records for cells, modules and arrays. After Varian he founded two start-ups, including High Yield Technology, where he pioneered the first commercially successful in situ particle monitoring systems for VLSI process equipment, and Boxer Cross, Inc., where he developed, marketed and sold metrology systems for VLSI process control. Dr. Borden is an Adjunct Professor at Santa Clara University, where he teaches graduate classes in photovoltaics. He holds Ph.D. and MS degrees in Applied Physics from Stanford and BS degrees in Physics and EE from MIT, where he graduated Phi Beta Kappa. Dr. Borden is the author of over 80 publications in the fields of photovoltaics, silicon and III-V devices and processing, and VLSI process monitoring, and has over 60 patents.

3:00 – 3:30 “Kerf-Free Wafering: Technology Innovation for Crystalline Silicon”, Francois J. Henley, Silicon Genesis Corporation, San Jose, CA

Abstract:

In 2010, upwards pricing trends were significant in polysilicon and wafer supply, and continued even after the peak season of PV installation had passed. The “gold rush” outlook continues, however policy action inhibiting the demand is likely to accelerate with Germany following suit reducing the Feed-in-Tariff putting pressure again on cost reduction. The wafer still represents approximately 60% of the total module cost and the silicon represents 50% of the wafer cost. A number of kerfless wafering processes have been developed and introduced over the last several years. SiGen has developed the PolyMax™ process based on ion beam-induced cleaving of crystalline silicon and has been demonstrated to be capable of producing high quality c-Si wafers in thicknesses ranging from 20 microns to 150 microns. The presentation will describe the PolyMax technology and a technical overview comparing the different kerfless approaches.

Biography

Mr. Henley is a co-founder of Silicon Genesis Corporation (“SiGen”) based in San Jose California. Founded in 1997, SiGen is an advanced nanotechnology company that develops silicon-on-insulator (SOI), strained-silicon products and other engineered multi-layer structures to the microelectronics and photonics industries for advanced electronic and opto-electronic device applications. Prior to SiGen, Mr. Henley was the co-founder, President, and COO of Photon Dynamics (NASDAQ:PHTN), the world leader in Flat-Panel Display LCD production test equipment and yield management solutions. Mr. Henley was also the founder and principal engineer of Dataprobe Corporation, a developer of laser-based test for semiconductor devices. Mr. Henley holds a B.S.E.E. degree from Rensselaer Polytechnic Institute and an M.S.E.E. from the University of California Berkeley, where he also completed Ph.D. course requirements in quantum electronics and semiconductor materials science. He is also a graduate of Stanford Business School's Executive Program for Small Company Presidents. Mr. Henley has written over 30 papers and articles, and holds over 75 patents in the areas of metrology and SOI wafer fabrication.

3:30 – 4:00 “Characterization of Contamination in PV Materials”, Ian Mowat, Karol Putyera, Larry Wang, Temel Buyuklimanli and Gary Mount, Evans Analytical Group, Sunnyvale, CA

Abstract:

Contamination is an important factor affecting the conversion efficiency of solar cells. Highest purity materials tend to deliver the best conversion efficiencies but at the highest cost. Lower purity materials cost less and by focusing on the control of key elements, conversion efficiency can approach those of high purity. In this work we look at methods for contaminant analysis and report on strengths and limitations. Bulk sampling methods and profiling methods are discussed. Contaminants in c-Si, α -Si, μ c-Si, mc-Si, CdTe and CIGS technologies can be measured and we report on results.

Biography:

Ian Mowat is director of sales for the surface analysis and materials characterization division of EAG (Evans Analytical Group). He obtained a BS in chemistry followed by a PhD in laser mass spectrometry of synthetic polymers, both from the University of Edinburgh, Scotland. Following that, he worked at the University of Kent, Canterbury, England on the analysis of explosive vapors using atmospheric pressure glow discharge mass spectrometry. He joined EAG in 1996 (Charles Evans & Associates, at that point), working as an analyst in the TOF-SIMS group. Since then, he has worked in various other analytical groups including SIMS and FTIR, moving into a sales role in 2008.

4:00 – 4:30 “Thin Film Applications and Equipment Solutions for Photovoltaic Applications”, Don Veri, Roth & Rau, USA.

Abstract:

Within the Photovoltaic's market a wide variety of solar cell formats exists. The range of formats includes thin film, single junction, multi junction and heterojunction and organic/flexible cell/device structures. Today and in the foreseeable future, the single junction crystalline based solar cell format remains a dominant cell format. The efficiency potential of this cell format continues to evolve. Additionally, the evolution of heterojunction cell formats using crystalline based wafer substrates represents significant potential for efficiency gains. This discussion provides information on applicable deposition applications, processes and equipment platforms that enable and contribute to the creation of higher efficiency cell formats using standardized equipment platforms.

Biography:

Mr. Veri has been active in the renewable energy and technology / process automation sector for the past 25 years. He has held executive management and business / commercial development positions within industry leading companies of Roth & Rau USA, (a wholly owned subsidiary of Roth & Rau AG), OTB Solar/OTB Group, Toolex International and Metatec Corporation. Currently he holds the position of Vice President of Sales for Roth & Rau USA and is responsible for sales and business development activities in North American. Mr. Veri was a founding member of OTB Solar's Management Team and has been instrumental in business and product strategy / development for PECVD technologies, Industrial Ink Jet Print Systems and the growth of the business up to the sale of the company to Roth & Rau in 2010.

4:30 – 5:00 Poster Announcement

5:00 – 6:00 Exhibition Reception