NextGen PV : International outlook @ IPVF

Amphi Edmond Becquerel, September 23, 14-17h

Title of talk: PV research and deployment in Singapore

Abstract: This talk describes recent solar photovoltaic R&D activities at the Solar Energy Research Institute of Singapore (SERIS) in the areas of solar cells, PV modules and PV systems. Furthermore, it outlines innovative deployment options that will help the land-constrained city-state to achieve its installed solar capacity target of more than 2 GW_p by 2030.

Prof Armin ABERLE serves as CEO of the Solar Energy Research Institute of Singapore (SERIS) at the National University of Singapore (NUS). He is also a tenured full professor in the university's Electrical and Computer Engineering Department. His research focus is on photovoltaic (PV) materials, devices and modules. He has (co)authored more than 500 scientific-technical papers and has been supervising more than 60 PhD students in his career. In the 1990s he established and led the Silicon PV Department at the Institute for Solar Energy Research (ISFH) in Hamelin, Germany. He then worked for 10 years in Sydney, Australia as a solar energy professor at the University of New South Wales (UNSW) and a member of the UNSW team that developed and taught the world's first Bachelor of Engineering degree programme for Photovoltaic and Renewable Energy Engineering. In 2008 he joined NUS to establish SERIS, as the Deputy CEO and Director of the Silicon PV Department. Since 2012 he serves as SERIS CEO. He is also the Director of the institute's Next-Generation Industrial Solar Cells and Modules Cluster and the Acting Director of the Novel PV Concepts Cluster.

Title of talk: Research on high-efficiency tandem solar cells at Fraunhofer ISE

Abstract: Since PV installations will be the major source of our energy supply, high efficient solar cells are of importance for cost reduction and to reduce material consumptions. Fraunhofer ISE is pushing the efficiency since many years in the field of Silicon and III-V-based solar cells. Specifically, the latter semiconductor material is well-known for tandem structures. Using a four-junction cell we could achieve record efficiencies of 47.1 % under concentrated sunlight illumination. Silicon solar cells are approaching their practical limits – with a TOPcon structure ISE achieved a 26.1 % efficiency – therefore the next step are tandem structures using Silicon material as bottom cells. Fraunhofer ISE combines III-V materials on Silicon and investigates Perovskite on Silicon. The presentation will discuss challenges and research path for both tandem approaches

Prof. Dr. Andreas W. BETT is director of the Fraunhofer Institute for Solar Energy Systems ISE in Freiburg, Germany and operates the chair "Solar Energy Materials and Technologies" in the Faculty of Mathematics and Physics, University of Freiburg. He received the Dipl. degree in physics and the state examination in physics and mathematics from the University of Freiburg, Germany in 1988 and 1989, respectively and the PhD degree in physics from the University of Konstanz, Germany in 1992. He joined the Fraunhofer Institute for Solar Energy Systems, ISE in 1987. In 1993 he became the head of the group "III-V epitaxy and solar cells". From 2007 until 2016 he was division director "Materials – Solar Cells and Technology" and from 2009 until 2016 he was deputy director of the institute. In 2017 he was appointed director of the institute. The main areas of research of Prof. Dr. Andreas Bett include materials for photovoltaic cells, epitaxial growth of Si and III-V semiconductors, development of tandem solar cells and characterization techniques for advanced solar cell devices. Furthermore, he develops concentrator module and systems and is involved in field testing. For his scientific achievements he was honored with several prestigious prizes. He has organized several international conferences and served in many scientific committees. He was also co-founder of the company Concentrix Solar in 2006 and in 2015 of the company NexWafe.

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Title of talk: **Dye-sensitized and perovskite solar cells with record level efficiencies**

Abstract: Some years back we introduced alkoxy functionalized donor groups as a building block in organic dyes as light harvesters for DSSC. This donor group provides a desirable 3-dimensional structure that aids in surface protection of electrons injected into the semiconductor from oxidants in the electrolyte, allowing for record-setting cobalt- and copper-based redox shuttles to be utilized more frequently. With these systems we recently set a certified world record efficiency for DSSC of 13%. DSSCs are ideally suited for ambient light and indoor applications where efficiencies up to 35% have been reached calculated with respect to the fluorescent light source.
For perovskite solar cells we have developed methods to accomplish a stable FAPbI3 phase. We found, for example, that a film of the photoinactive yellow δ- phase was converted to a highly crystalline black α-phase by vapor exposure to methylammonium (or formamidinium) thiocyanate at 100°C, and it retained this structure after 500 hours at 85°C. We have also introduced an anion engineering concept that uses the pseudo-halide anion formate (HCOO−) to suppress anion-vacancy defects that are present at grain boundaries and at the surface of the FAPbI3 films. The resulting solar cell devices attain a power conversion efficiency of 25.6 per cent (certified 25.2 per cent). In our most recent work we have obtained record level efficiencies of of 23.3%, 21.7% and 20.6% with active areas of 1, 20 and 64 cm2, respectively

Prof Anders HAGFELDT is Vice-Chancellor of Uppsala University and Professor of Physical Chemistry. He obtained his PhD from Uppsala University in 1993 and is a specialist in solar energy conversion. His research has established him as an international leader in the fields of dye-sensitised solar cells, perovskite solar cells and solar fuels. Times Higher Education ranked Hagfeldt number 46 in the top 100 material scientists during 2000–2010, and he was among the top 1% cited chemists in the THE ranking for 2014–2021. Hagfeldt became Professor of Chemical Physics at Uppsala University in 2004 and Professor of Physical Chemistry in 2007. From 2014 to 2020, he was Professor of Physical Chemistry at the Federal Institute of Technology Lausanne (EPFL), Switzerland.

Title of talk: **Improving PV Reliability and Investability with Extended-Stress Testing. Why a Scientific Basis is Both Essential & Impossible**

Abstract: Solar panels typically are expected to last decades, yet small changes in the panels can lead to early failure. How does one assess the expected life of a solar panel. Historically, standardized testing has been extremely helpful in identify panels that are robust to early failure. Can we develop an extended stress test that will enable us to assess the likelihood decades of life? The challenge is that solar panels fail for different reasons and with different dependencies on stress. The talk will explain why a scientific basis for an extended stress test is both essential and impossible.

Prof Sarah KURTZ obtained her PhD in 1985 from Harvard University and now works at the University of California Merced after more than 30 years working at the National Renewable Energy Laboratory, in Golden, CO. She is known for her contributions to developing multijunction, GaInP/GaAs solar cells, supporting the Concentrator Photovoltaic (PV) industry, and leading efforts on PV performance and reliability. Her work has been recognized with a jointly received Dan David Prize in 2007, the Cherry Award in 2012, C3E Lifetime Achievement Award in 2016, and induction into the National Academy of Engineering in 2020. At the University of California Merced she is working both to help the university grow and to support the Energy Transition through a variety of studies, including a current study on long-duration energy storage .