## ePOWER Seminar

# *AC solar cells: A new breed of PV power generation*

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**Abstract:** A solar cell inside a photovoltaic (PV) panel inherently produces dc output which needs to be processed and inverted for ac applications. Using a modern manufacturing facility, PV panels could be mass produced without any apparent issues. Unfortunately, power converters used in PV systems are still made of discrete components and are not suitable for mass production. The power engineering and automation research lab (PEARL) team at University of Utah aims to introduce a breakthrough technology to generate 120V/240V ac output directly from the panel. Therefore, the individual PV strings inside the panel would produce ac output rather than dc. All circuit components are embedded on the same substrate material (for now, this is rather expensive single crystal Si, ultimate integration will be done with least expensive thin film or poly-Si) to integrate both the PV cells and the converter unit without using any discrete components and interconnections.

The proposed silicon processing technique will provide a guideline for solar cell designers to fabricate various discrete components in a power converter circuit including capacitors, MOSFETs/IGBTs/JFETs and other necessary components to ensure the maximum power point tracking (MPPT) operation along with the necessary dc-ac conversion. The PEARL team envisions developing an inductor-free switched capacitor circuit to harness PV power in a grid-tied architecture, and the team has an established research history in the field of capacitor-clamped converters.

This novel integration is likely to reduce the installation complexity, resulting in a significant cost saving. With a successful completion of this research, a PV power system will be a “one unit plug and play” system with direct interconnection to the grid having the capability to eliminate the “hotspot” and partial shading problems present in large size panels and will ensure maximum power harvesting at challenging illumination situations – with a substantial 10%-20% cost reduction ($/W). In addition, the use of monolithic integration and smart choice of power converters would result in a maximum power savings of 23% and would thus encourage a greater adoption of multi-junction solar cells. This modular solution is highly repetitive and is likely to reduce the energy cost involved in the manufacturing process of conventional power converters made from discrete components.

**Biography**: Prof. Faisal Khan received his BSc, MS and PhD degrees from Bangladesh University of Engineering and Technology, Arizona State University, and University of Tennessee in 1999, 2003 and 2007 respectively – all in electrical engineering. From 2007-2009, Dr. Khan has been with the Electric Power Research Institute (EPRI) as a senior power electronics engineer. Since 2009, he has been an Assistant Professor in the electrical and computer engineering department of the University of Utah. Dr. Khan’s major area of interest is high-power capacitor-clamped converters. However, since his appointment at the university, Prof. Khan has extended his research into the field of photovoltaics. Presently he is involved in the cell-level power converter design for single junction and multi-junction solar cells. Prof. Khan is the founder of the Power Engineering and Automation Research Lab (PEARL) of the University of Utah. Under his supervision, PEARL has proposed revolutionary “AC solar cells” that are presently under fabrication. In addition, Prof. Khan is also involved with renewable energy research including wind energy harvesting using split-phase induction generators and grid-tied energy storage. Prof. Khan is a member of the IEEE Power Electronics Society, Industry Applications Society and Industrial Electronics Society. He is the recipient of the 2007 IEEE IAS first prize paper award for his contribution to high power modular multilevel dc-dc converters. He is the award chair of IEEE ECCE 2012 and the general chair of IEEE COMPEL 2013 in Salt Lake City.