Process-to-Panel Modeling of Silicon Heterojunction Technology (PV-4)

A joint India-U.S. research consortium funded under the *Joint Clean Energy Research & Development Center (JCERDC)*

Scientific Achievement:

Developed an end-to-end modeling framework for silicon heterojunction (HJ) solar cell technology to investigate the implication of fabrication process variability on the cell and ultimately on the module (panel) performance.

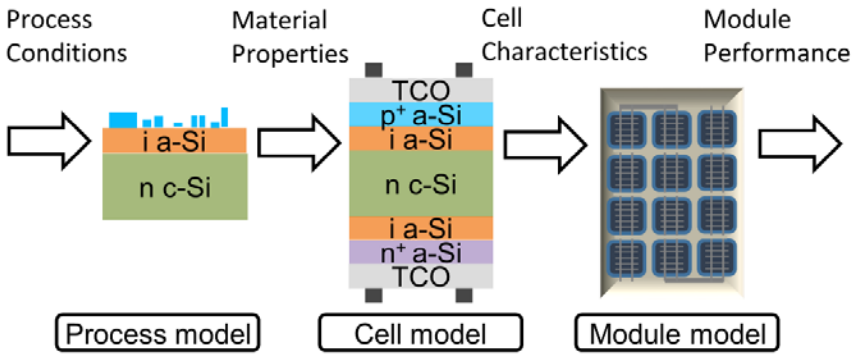
Significance and Impact:

This first-of-its-kind work for silicon HJ technology is useful for (1) rapid prototyping of design/processes for photovoltaic industries ramping up their manufacturing and (2) quality control studies in established fabrication cycles.

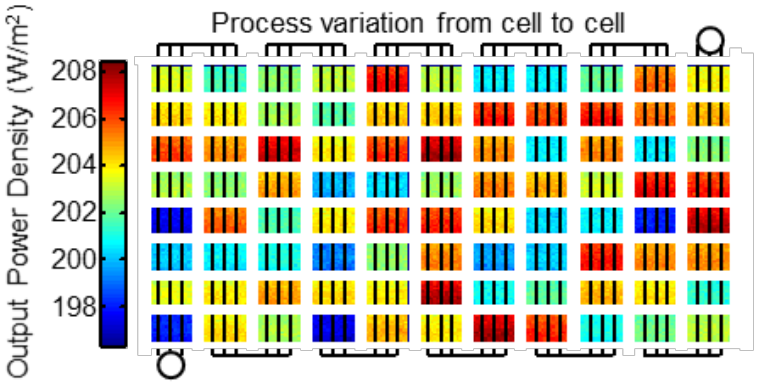
Research Details:

This work involves developing compact models for a-Si process conditions (developed at MIT), and silicon HJ solar cell and modules (developed at Purdue).

- PECVD-deposited a-Si on c-Si process model inputs the process conditions and provides the a-Si film properties as outputs.
- The physics-based HJ cell model inputs the a-Si film properties and provides the cell I-V characteristics.
- The multi-scale module model developed using HSpice and Verilog-A provides the module performance metrics using the individual cell characteristics.



The end-to-end modeling framework for silicon heterojunction solar cell technology.



Output power density (W/m^2) of a silicon HJ module. The cell-to-cell process variation can significantly impact the power that can be extracted from the module.

Publication: R.V.K. Chavali, E.C. Johlin, J.L. Gray, T. Buonassisi, M.A. Alam, A framework for process-to-module modeling of a-Si/c-Si heterojunction solar cells to investigate the cell-to-module efficiency gap, *IEEE J. Photovoltaics*, in review (2016).

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