NANOMATERIALS SPEAKER SERIES

# PEROVSKITE SOLAR CELLS: MATERIALS SYNTHESIS, DEVICE OPERATION AND CHARGE CARRIER DYNAMICS

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Organic-inorganic hybrid halide perovskites have rapidly become a focal point of the photovoltaic (PV) community as a promising next-generation PV technology. Various perovskite absorbers (e.g., $CH_3NH_3PbI_3$ and $HC(NH_2)_2PbI_3$) and device architectures (e.g., mesoporous, planar, and mesoporous-planar hybrid cell configurations) have been examined with promising results by using either solution processing or thermal evaporation. The certified efficiency of a single-junction perovskite solar cell (PSC) has reached 22% after only a few years of active research. In addition to solar cell application, the fascinating optical and electronic properties of these perovskite systems have enabled their usage for various electronic devices including light emitting diodes, photodetectors, and transistors. Despite this remarkable progress associated with perovskites, there are still many fundamental questions to be addressed at both material and device levels. Further improvements are required to advance our understanding on the material effects on the fundamental physical and chemical processes that are important to device operations. In this presentation, I will first provide an overview of the PSC field. I will then present our recent studies toward a better understanding and control of perovskite nucleation, grain growth, and microstructure evolution using solution processing. The impact of grain size on charge carrier dynamics was also studied. I will discuss briefly the role of grain boundary on charge carrier dynamics and device characteristics. These results and others will be discussed. Finally, I will discuss the R&D opportunities to make perovskite solar cells a viable photovoltaic technology in the future.

**Kai Zhu**

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## SPEAKER BIO

Kai Zhu is currently a senior scientist in the Chemistry and Nanoscience Center at the National Renewable Energy Laboratory (NREL). He received his PhD degree in physics from Syracuse University in 2003. Before this position, he worked as a postdoctoral researcher in the Basic Science Center at NREL, focusing on fundamental charge carrier conduction and recombination in photoelectrochemical cells, especially dye-sensitized solar cells. Dr. Zhu's research on dye-sensitized solar cells involves the development of advanced electrode materials/architectures, basic understanding of charge transport and recombination processes in these electrodes, and thin-film solar cell development/characterization/modeling. His recent research has centered on both basic and applied research on perovskite solar cells, including perovskite material development, device fabrication and characterization, and basic understanding of charge carrier dynamics in these cells. In addition to solar conversion applications, his research interests have also included III-Nitride wide-bandgap semiconductors for high-power blue and UV light emitting diodes and ordered nanostructured electrodes for Li-ion batteries and supercapacitors.

Contact Professor Jiming Bao at jbao@uh.edu if you would like to arrange for a time to meet with Dr. Zhu.

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