Seminar Talk

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Title: Effect of Grain Size and Interface Engineering On the Photovoltaic Performance and Stability of Perovskite Solar Cells

Abstract:

Organic-inorganic halide perovskite solar cells (PSCs) have grown rapidly in recent years due to their outstanding optoelectronic properties, high efficiency and low-cost balance. However, there are still some problems such as defects, hysteresis, and long-term stability, which need to be addressed in order to make commercially available perovskite solar cells. Perovskite (CH3NH3PbI3-xClx) thin films were investigated using two-dimensional (2D) chemical mapping measurements which revealed that the grain boundaries (GBs) contained non-stoichiometric PbIx or CH3NH3PbIx with enriched oxygen and iodide vacancies. In addition, 2D photoluminescence (PL) and lifetime mapping measurement suggested the presence of defect levels at GBs. Consequently, a hot-casting technique was used to increase the grain size and reduce the effect of defective grain boundaries, which resulted in increased photo conversion efficiency up to ~12.5%. Even though perovskite solar cells with larger grain films showed improved efficiency, the interface defects at perovskite/electron transport layer (ETL) interface lead to light soaking effect and notorious photocurrent hysteresis. Therefore, a novel PCBM/carbon based ETL was incorporated into the device, which increased the efficiency to ~16% by passivating interface defects and by improving series and shunt resistance. In addition, the earth abundant and low-cost carbon removed the hysteresis effect with increased charge extraction through GIs and GBs. Despite the great potential of PSCs for future energy needs, the air instability of PSCs poses a serious threat to their commercialization. In this context, we introduced a polymer of polyimide and NiOx based HTL to improve air stability by encapsulating the PSCs.

Bio:

Abdullah Al Mamun received the B.S. and M.S. degrees in Applied Physics, Electronics, and Communication Engineering from University of Dhaka, Dhaka, Bangladesh in 2012 and 2014, respectively. He is currently pursuing the Ph.D. degree in Electrical and Computer Engineering at Old Dominion University, Norfolk, VA, USA. His doctoral dissertation focuses on the design, fabrication and characterization of an emerging photovoltaic device known as perovskite solar cell.

During his Ph.D. study, he has published 10 research articles in high impact factor journals and 5 conference proceedings. As a recognition of his research, he was awarded “PhD Researcher of the Year-2017” by Old Dominion University.