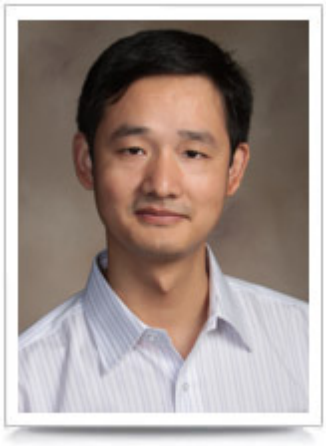
University of Nebraska Lincoln | NEBRASKA CENTER FOR ENERGY SCIENCES RESEARCH

Cycle 9
January 2015



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Design and Development of High-Efficiency, Low-Cost Perovskite Solar Cells

Abstract.

Perovskite is emerging as a new generation, inexpensive, easy-to-make material for solar cell applications. The efficiency of perovskite solar cells has increased to more than 15% in three years, an improvement which generally takes decades to achieve for any other type of solar cell. Huang's research group has developed a novel low-temperature, low-cost solution process, which boosted efficiency to a record value of 15-17%. This project aims to establish a research team in perovskite solar cell research at the University of Nebraska-Lincoln to prepare for the next wave of funding opportunities. We will address the most fundamental understanding of perovskite solar cells to explain why this material works so well for the photovoltaic effect. Specifically, we will achieve the following three subobjectives: 1) determine the material composition and process-dependent doping mechanism in perovskite materials; 2) understand the influence of bulk and surface defects on the electronic property of perovskite thin films and the mechanism of defects and passivation by the double fullerene layer; and 3) boost the device efficiency with defect-controlled doping engineering. Understanding these fundamental issues will pave the way for a future search for even better materials for photovoltaic applications. The proposed research will also provide a pathway toward the integration of perovskite solar cells with silicon solar panels, which can boost the efficiency of solar cells beyond the Shockley-Queisser limit and lower the price of silicon solar panels. This project leverages an existing collaboration between three PIs from different backgrounds: material growth, material characterization, and device engineering and computation.