Perovskite-Based Solar Cells

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This special series of the *Journal of Photonics for Energy* focuses on the science and technology of the so-called perovskite-based solar cells. These materials have been named for their perovskite crystal structure that adopts an ABX$_3$ composition, where for example A = formamidinium-FA, methylammonium-MA, Cs, and/or Rb; B = Pb$^{2+}$, and/or Sn$^{2+}$; and X = Cl$^-$, Br$^-$, and/or I$^-$. These materials have gained a lot of attention due to rapid rise in performance, reaching current record certified efficiencies of 22.1%. In spite of their quickly achieved high efficiencies, there is still much to learn about the synthesis and properties of these materials. Here we display a series of new findings and perspectives on a variety of related topics.

The collection of papers were published in the *Journal of Photonics for Energy*, throughout Volumes 6 and 7:


Mohamad Goudarzi et al. present a simulation of two different processing methods for the inverted perovskite solar cell geometry and report a drastically different interface defect density between the two preparations. Mehran Habibi et al. describe a spray coating method for sequentially depositing planer perovskite-based solar cells, addressing a critical need for scalable processing methods for these materials. Szostak et al. present a comprehensive study into the intramolecular exchange method for synthesizing perovskite-based MAPbI$_3$ solar absorbers and propose a mechanism for the direct formation of the MAPbI$_3$ film. Haitao Peng et al. explore the potential to replace TiO$_2$ with CdS as a higher performing electron transport layer of a perovskite-based solar cell, achieving a photoconversion efficiency of 16.1%.

Soosaimanickam Ananthakumar et al. provide a review of the synthesis, properties, and applications for cesium lead halide perovskite quantum dots (QDs). These QDs have higher quantum yield (90%) than any other semiconductor QDs making them a promising candidate for a variety of device applications. Since this report researchers have reported CsPbI$_3$ QD devices with a certified device efficiency of 13.43%, a current QD device record. Alex Hariz and
Zhaoning Song et al. present two perspective views on perovskite-based solar cells and provide commentary on potential pathways to higher performance.

The articles in this special series provide a snapshot of the rapidly advancing field of perovskite-based solar cells. We hope these works provide inspiration for new areas of research while also providing a perspective outlook on this exciting field.

References


Ana Flavia Nogueira received her PhD degree in chemistry from the University of Campinas (UNICAMP), Campinas, Brazil, in 2001. In 2002, she joined the group of Professor James R. Durrant at Imperial College, London, in a postdoctoral position. Since 2004, she has been an associate professor at UNICAMP. She is also the coordinator of the Laboratory of Nanotechnology and Solar Energy, a leading group in third-generation solar cells in Brazil.

Laura T. Schelhas received her PhD in chemistry from the University of California, Los Angeles (UCLA) in 2013. In 2014, she accepted a postdoctoral position at the Stanford Synchrotron Radiation Lightsource (SSRL) at SLAC National Accelerator Laboratory before becoming staff in 2016. She is currently an associate staff scientist in the Applied Energy Programs Division at SLAC. Her research focuses on understanding the structure function relationship in both solar absorbers and solar modules materials such as encapsulants, backsheets, and anti-reflective/anti-soiling coatings.