3-12-2021

Energy Spotlight: Advances in LIB Electrolyte, Stabilizing CsPbBr3 in Mesoporous Silica, and Halide Segregation in Mixed Halide Perovskites

Nam-Soon Choi
Ulsan National Institute of Science and Technology

Javier Vela
Iowa State University, vela@iastate.edu

Jeffrey DuBose
University of Notre Dame

Prashant V. Kamat
University of Notre Dame

Energy Spotlight: Advances in LIB Electrolyte, Stabilizing CsPbBr3 in Mesoporous Silica, and Halide Segregation in Mixed Halide Perovskites

Abstract

One of the biggest developments of the past decade in the field of colloidal semiconductors is the introduction of lead halide perovskite nanocrystals. Because of their low cost, ease of synthesis, and near ideal optical properties, these materials are versatile building blocks for light-emitting displays, solar cells, environmental sensors, and radiation detectors.

Disciplines

Energy Systems | Materials Chemistry | Polymer and Organic Materials

Comments

This is a manuscript of a portion of an editorial published as Choi, Nam-Soon, Javier Vela, Jeffrey DuBose, and Prashant V. Kamat. "Energy Spotlight: Advances in LIB Electrolyte, Stabilizing CsPbBr3 in Mesoporous Silica, and Halide Segregation in Mixed Halide Perovskites." *ACS Energy Letters* 6, no. 3 (2021): 1150-1152. DOI: 10.1021/acsenergylett.1c00417. Posted with permission.

One of the biggest developments of the past decade in the field of colloidal semiconductors is the introduction of lead halide perovskite nanocrystals. Because of their low cost, ease of synthesis, and near ideal optical properties, these materials are versatile building blocks for light emitting displays, solar cells, environmental sensors, and radiation detectors. Unfortunately, as with their bulk counterparts, naked halide perovskite nanocrystals have poor stability, easily degrading under conditions of high humidity, heat, or under continuous illumination. Epitaxial coating and encapsulation with polymers, metal-organic frameworks and, in particular—due to their high thermal and chemical stability—mesoporous oxides, enables the preparation of more stable halide perovskites. Nevertheless, the composites produced so far failed to retain the high photoluminescence emission that characterizes these materials.

In this issue, Ann, De Trizio, Manna and coworkers use molten salts as a suitable medium to prepare cesium lead tribromide–mesoporous silica composites under mild conditions—350 °C in air.(An, M. N.; Park, S.; Brescia, R.; Lutfullin, M.; Sinatra, L.; Bakr, O. M.; De Trizio, L.; Manna, L. “Low-Temperature Molten Salts Synthesis: $CsPbBr_3$ Nanocrystals with High Photoluminescence Emission Buried in Mesoporous SiO_2.”*ACS Energy Lett.* **2021**, *6*, 900–907. DOI: 10.1021/acsenergylett.1c00052) The resulting $CsPbBr_3$/mesoporous-SiO_2 composites possess very high photoluminescence efficiency—89 %—as well as heat and water stability. Notably, such optical and physical properties were found to be intimately linked to the exact molten salts employed: The use of potassium bromide and nitrate preserves the high photoluminescence, while the addition of sodium nitrate leads to the sealing of the silica pores and confers stability.

As proof-of-concept, the authors prepared a downconverting white-light emitting diode exhibiting a correlated color temperature of 7692 K, with highly stable PL emission after 240 h of operation. The composites reported are stable after immersion in saline water at 90 °C for 7 days. They even survive in *aqua regia*—a highly corrosive mixture of hydrochloric and nitric acids. Extension of this method to the ever-growing number of perovskite nanomaterials, including those that are lead-free, bears great promise in myriad technological applications.