Mechanochemical synthesis of Sn-based halide perovskite microcrystals

Xuan Huang,[a,b†] Xiaobing Tang,[a,c†] Y. Charles Lu[a,b*] and Fuqian Yang[a,c*]

[a] *Laboratory of Functional Materials*

[b] *Department of Mechanical and Aerospace Engineering*

[c] *Department of Chemical and Materials Engineering*

University of Kentucky, Lexington, KY 40506, USA

Abstract

Hybrid organic halide perovskites have shown promising potential in optoelectronic applications such as solar cells and light-emitting devices. The lead-based halide perovskites exhibit exceptional light emission and absorption capabilities while the inherent toxicity from Pb has limited their applications. In this work, we synthesize a series of lead-free Sn-based halide perovskite microcrystals under ambient conditions directly from precursor powders (CsX and SnX_2 (X=I, Br, Cl)) via a mechanochemical technique. This technique conserves energy and avoids the use of hazardous solvents. There are phase evolutions with $CsSn_2Br_5$ to $CsSnBr_3$ and then to the stabilized phase of Cs_2SnBr_6 after 28 days and Cs_2SnCl_4 to $CsSnCl_3$ and then to the stabilized phase of Cs_2SnCl_6 after 36 days during the mechanochemical synthesis. The stabilized Cs_2SnI_6 powder emits light with a peak wavelength of 930 nm when excited by 785 nm, and the stabilized Cs_2SnBr_6 powder emits light with a peak wavelength of 682 nm when excited by 365 nm. The thermal stability of the Cs_2SnBr_6 powder is superior to that of the Cs_2SnI_6 powder. This work presumably provides a green route for the synthesis of lead-free halide perovskites for industrial scale production.

Biography of Presenter

Xuan Huang

BS, Mechanical Engineering, Changzhou University, China, 2021

PhD candidate, Mechanical and Aerospace Engineering, University of Kentucky, 2023 -

Teaching assistant, Mechanical and Aerospace Engineering, University of Kentucky

Research Topics: tin-based perovskite crystals by MCS tin-based perovskite solar cell, tin halide perovskite light-emitting diode