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Electro-hydrodynamic spray synthesis and low temperature spectroscopic characterization of Perovskite thin films¹ SOM SARANG, HIDE-TAKA ISHIHARA, VINCENT TUNG, SAYANTANI GHOSH, University of California Merced — Utilizing a Marangoni flow inspired electro-spraying technique, we synthesize hybrid perovskite (PVSK) thin films with broad absorption spectrum and high crystallinity. The precursor solvents are electro-sprayed onto an indium tin oxide (ITO) substrate, resulting in a gradient force developing between the droplet surface and the bulk due to the varying vapor pressure in the bi-solvent system. This gradient force helps the droplets propagate and merge with surrounding ones, forming a uniform thin film with excellent morphological and topological characteristics, as evident from the average power conversion efficiency (PCE) of 16%. In parallel, we use low temperature static and dynamic photoluminescence spectroscopy to probe the grain boundaries and defects in the synthesized PVSK thin films. At 120 K, the emergence of the low temperature orthorhombic phase is accompanied by reduction in lifetimes by an order of magnitude, a result attributed to charge transfer between the orthorhombic and tetragonal domains, as well as due to a crossover from free charge carrier to excitonic recombination. Our fabrication technique and optical studies help in advancement of PVSK based technology by providing unique insights into the fundamental physics of these novel materials.

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