Title:	Stable CsPbI3-Mesoporous Alumina Composite Thin Film at Ambient Condition: Preparation, Characterization, and Study of Ultrafast Charge-Transfer Dynamics
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Keywords:	Thin films Organic polymers
Issue Date:	2021
Publisher:	ACS Publications
Citation:	The Journal of Physical Chemistry C, 125(6), 3285–3294.
Abstract:	Among the all-inorganic lead halide perovskites, CsPbI3 has emerged as a competent photovoltaic material because of its enhanced stability and comparable efficiency to that of organic–inorganic hybrid perovskites, but the main constraint lies in the phase instability of the active cubic α-CsPbI3 perovskite at room temperature as it degrades to nonperovskite yellow-colored phase. Herein, we describe the synthesis of the active cubic α-CsPbI3 perovskite along with orthorhombic in the presence of surface capping agent poly-vinylpyrrolidone (PVP) inside a mesoporous alumina film, which restricts its interaction with air and moisture, leading to significantly enhanced stability of the composite film. Moreover, the conversion rate from the active cubic (α) to inactive yellow δ (orthorhombic) phase is found to be nominal in a time period of minimum 8 months. The as-synthesized composite CsPbI3–alumina film is found to be stable at ambient condition. To examine the charge-transport property of this stable composite film in a thin film device setup, electron and hole transport layers are used and femtosecond transient absorption spectroscopy is employed, all at room temperature and ambient condition, to investigate the charge-transfer kinetics of PVP-capped CsPbI3 in mesostructured alumina. The spectral data confirms the efficient charge transfer occurring from CsPbI3 to charge-conducting layers, and the electron and hole transfers happen in 40 ps and 600 fs, respectively. This study is expected to encourage new possibilities of using a surface capping agent as well as a mesostructured layer to synthesize and confine stable active perovskite nanocrystals useful for practical photovoltaic applications.
Description:	Only IISER Mohali authors are available in the record.
URI:	https://pubs.acs.org/doi/10.1021/acs.jpcc.0c10260 (https://pubs.acs.org/doi/10.1021/acs.jpcc.0c10260) http://hdl.handle.net/123456789/5139 (http://hdl.handle.net/123456789/5139)
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