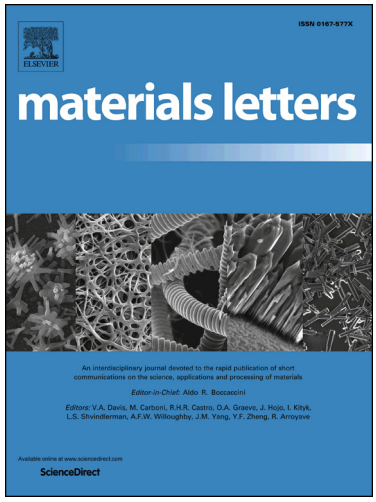
Accepted Manuscript



Formamidinium lead iodide perovskite: Structure, shape and optical tuning via hydrothermal method

Govindhasamy Murugadoss, Rangasamy Thangamuthu, Manavalan Rajesh Kumar

PII: S0167-577X(18)31194-7
DOI: https://doi.org/10.1016/j.matlet.2018.08.003
Reference: MLBLUE 24714

To appear in: *Materials Letters*

Received Date: 29 June 2018
Revised Date: 28 July 2018
Accepted Date: 2 August 2018

Please cite this article as: G. Murugadoss, R. Thangamuthu, M. Rajesh Kumar, Formamidinium lead iodide perovskite: Structure, shape and optical tuning via hydrothermal method, *Materials Letters* (2018), doi: https://doi.org/10.1016/j.matlet.2018.08.003

Formamidinium lead iodide perovskite: Structure, shape and optical tuning via hydrothermal method

Govindhasamy Murugadoss [a,*], Rangasamy Thangamuthu[a], Manavalan Rajesh Kumar[b]

[a]*Materials Electrochemistry Division, CSIR-Central Electrochemical Research Institute, Karaikudi 630 003, Tamilnadu, India*

[b]*Institute of Natural Science and Mathematics, Ural Federal University, 620002 Yekaterinburg, Russia*

Abstract

In this letter, we introduced a novel method for the preparation of room temperature stable α-$FAPbI_3$ perovskite without using organic ligands and mixed cations by hydrothermal method. Structural, optical and morphology of the product were changed with respect to the temperature. Equal volume of the chlorobenzene anti-solvent was used together with perovskite solution to saturate and simply growing the perovskite crystals under hydrothermal method. Optimum temperature (140 °C) was determined from XRD and UV-vis absorption result achieving stable α-$FAPbI_3$ perovskite. This work favours the understanding of the large scale with stable α-$FAPbI_3$ perovskite with interesting morphology, and paves the way for potential applications in diverse field.

Keywords: Perovskite; Solar energy materials, stability; structure; large scale.

*Corresponding author Email: murugadoss_g@yahoo.com

1. Introduction

Organic−inorganic hybrid lead halide perovskites have become one of the most intensively investigated compounds owing to their advantageous physical and chemical properties for photovoltaic application [1-4]. Even though room temperature stable methylammonium lead triiodide ($CH_3NH_3PbI_3$ or $MAPbI_3$) has been the most widely studied, formamidinium lead triiodide ($HC(NH_2)_2PbI_3$ or $FAPbI_3$) perovskite is gaining increasing interest for its narrow band gap [5-7]. The $FAPbI_3$ possesses a band gap of 1.43 eV and the corresponding absorption edge reaches 870 nm, which is superior to $MAPbI_3$ (820 nm) to serve as an efficient light harvester [8]. It was found that two polymorphs existing in $FAPbI_3$: (i) photoactive black trigonal perovskite (α-phase) above 160 °C and (ii) yellow hexagonal non-perovskite (δ-phase) at room temperature. The carrier diffusion lengths of α-$FAPbI_3$ were previously estimated to about 177 nm and 813 nm for electrons and holes, respectively [9]. Perovskite solar cells incorporating $FAPbI_3$ in absorber layer have achieved record certified power conversion efficiency of 22% [10]. Despite many studies on FA-based perovskite structures in thin film solar cells, the studies on intrinsic electrical, optical, and structural properties of $FAPbI_3$ still require for future applications. To date, most work on FA-based perovskites focuses on the stabilization of α-$FAPbI_3$ at relatively low temperature. Moreover, all the hybrid organic-inorganic perovskite crystals prepared by chemical method