$SnCl_2$を添加した鉛フリーハライドペロブスカイト薄膜および太陽電池の特性

Role of $SnCl_2$ as additive on lead-free halide Perovskite thin films and solar cell devices

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Tin halide perovskite solar cells have been investigated as primary alternative for lead halide based solar cells to solve the environmental impact for toxicity of lead [1]. However, the instability of divalent tin (Sn^{2+}) has been problematic, leading the low photovoltaic performance compared to methylammonium lead tri-iodide, $MAPbI_3$, based solar cells. Usually, excess tin halide, mainly SnF_2, has been used to overcome this instability issue since it has been proven to be effective for reducing tin vacancy upon fabrication [2]. Recent progress on tin halide perovskite solar cells demonstrated that the combination of excess tin (Sn^{2+}) and reducing conditions is the key for making tin halide based devices workable [3]. Besides SnF_2, $SnCl_2$ could be a potential additive since it meets the prerequisite, excess Sn^{2+} and reducing conditions. Additionally, inclusion of chloride have been reported to be uniquely beneficial for improvements in crystal growth and optical properties [4]. To date, however, only limited work has been reported to address the effectiveness of $SnCl_2$ as additive [5]. Therefore it is important to achieve extended study on the role of $SnCl_2$ for tin halide perovskites in order to obtain further insight into advantages and obstacles on the lead-free device performance and their optoelectronic properties.

We studied the phase characterization using X-ray powder diffraction, film morphology with scanning electron microscopy, and carrier lifetimes with optical measurements, together with device fabrication. The devices were fabricated using one step method with/without antisolvent dripping step, which turned to be partly influential for device performance. We will present further studies on improvement in the device performance and optical properties.

Part of this work was supported by JST, CREST (JPMJCR16N3) and IRCCS

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