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Synthesis and Characterization of Nanocrystalline $FASnI_3$ Perovskite

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Among the enumerable classes of semiconductor nanomaterials, metal halide perovskite nanocrystals (NCs) lately emerged for their unequalled opto-electronic properties, such as bright emission, strong light absorption, long-range charge mobility, which prefigure high performances in many applicative fields [1]. Non-toxic and environmental-friendly alternatives to the extensively studied lead-based perovskites are currently under investigation, and, among these, $FASnI_3$ compounds (where FA represents the formamidinium ion ($CH(NH_2)_2^+$)) have recently showed interesting properties at the bulk scale, employable especially in the photovoltaic field, thanks to the particularly suitable bandgap width in the NIR spectrum region [2]. In this work, we present the synthesis of novel $FASnI_3$ colloidal NCs and a thorough characterization of their structure and optical properties by means of both, routinary and advanced experimental techniques. Through an optimized hot-injection synthesis, we obtained pure and colloidally stable cuboidal NCs of about 10 nm in size, with maximum emission wavelength at 800 nm, efficiently preserving the material from Sn(II) oxidation, which is a crucial problem for all possible applications. The analysis of high-resolution synchrotron Wide Angle X-rays Total Scattering data, based on the construction of atomistic models combined with the Debye Scattering Equation computational approach [3], enabled us to determine the crystal structure, the internal structural disorder, and the NCs population descriptors, in terms of average size and polydispersity. The occasional detection of a defective tetragonal crystal phase ($FA_4Sn_5I_{14}$) with $\sqrt{5}:\sqrt{5}:1$ reconstruction will also be presented. Funding by MIUR, Project PRIN 2017L8WW48.

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