ABSTRACT **Index No.** 150/16/Phys./25

Title: Investigation on the synthesis and application aspects of organic-inorganic metal halide perovskites

Organic-inorganic metal halide perovskites, due to their excellent optoelectronic properties and budgetary preparation techniques, have recently shown significant research activities worldwide. Methylammonium lead iodide ($CH_3NH_3PbI_3$), one of the most important material among its family, has already demonstrated very good results in the photovoltaic and related fields. However, exploring its other application aspects, apart from photovoltaics and related studies, could reveal new possibilities and more understanding of its material properties. This dissertation is an attempt to this direction.

Morphology tuned various nanostructures of Methylammonium lead triiodide and devices based on the same are prepared through facile cost-effective routes. X-ray diffraction (XRD) technique is used to reveal the crystallographic nature of the synthesized materials, whereas UV-Vis-NIR, Fourier transformed infra-red (FTIR), X-ray photoelectron spectroscopy (XPS) and energy dispersive X-ray spectroscopy (EDS) etc. are used to know the energy band gap, detailed composition and stoichiometry. Field emission scanning electron microscopy (FESEM), transmission electron microscopy (TEM) are deployed for detailed morphological characterizations.

To explore the application prospects beyond photovoltaics, thorough investigation of electron field emission properties is carried out. Prominent emission as obtained from nanorods emitters is corroborated with theoretical simulations. Further enhancement in the emission performance is achieved by vertically oriented nanorods emitters under light illumination. Realizing the instability issue of perovskite based devices under ambient conditions, V_2O_5 nanorods are strategically incorporated into perovskite matrix to achieve robust as well as improved photodetection. Furthermore, bias dependent impedance analysis of $CH_3NH_3PbI_3$ in radio frequency regime unlocks bi-relaxation process through inductive switching. The findings also indicate another application aspect of $CH_3NH_3PbI_3$ as decoupling capacitor in electrical circuits.

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