INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: Investigation on Halide Perovskite Nanostructures and Thin Films for Optoelectronic and Solar Cell Applications

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SHORT ABSTRACT

This PhD thesis focuses on the controlled fabrication of perovskite nanostructures and thin films for photodetection, solar cell and other optoelectronic applications. The complete thesis work is presented in eight chapters. The first chapter presents a brief overview of the important properties, different growth and fabrication techniques, and the promising applications of metal halide perovskites. Next chapter presents the controlled fabrication of $CH_3NH_3PbI_3$ perovskite nanoparticles (NPs) on a mesoporous Si nanowire (NW) template and the mechanism of its high photoluminescence quantum yield. Next, we present a detailed investigation on the correlation between the strong cathodoluminescence (CL) and the PL emission, and the photoresponse characteristics of $CH_3NH_3PbBr_3$ perovskite NPs embedded in a mesoporous Si NWs template with high ambient stability. Next chapter presents a facile room-temperature bulk scale solid-state synthesis of highly luminescent color-tunable all-inorganic $CsPbX_3$ nanocrystals (NCs) with varying composition exhibiting superior optoelectronic performance and exceptional ambient stability. Further, a vertical type-II heterojunction photodetector was fabricated using $CsPbBr_3$ NCs on direct CVD grown large-area monolayer MoS_2 on Si/SiO_2 substrates. In chapter 5, we demonstrate a facile, solvent-free, bulk scale room temperature solid-state synthesis of highly stable and luminescent Mn-doped $CsPbCl_3$ NCs with high Mn substitution (40%), and investigate the origin and tunability of its dual-color emission. Next chapter presents an air processed high-performance self-powered hybrid perovskite photodetector with plasmonic Ag nanoparticles embedded in the hole-transport-layer, without the use of any electron-transporting layer. Next chapter discuss on the elevated substrate temperatures vacuum deposition of lead iodide thin film and its conversion into high-quality $CH_3NH_3PbI_3$ perovskite film using two-step vapor-solution deposition process for large-area perovskite solar cells with highly improved efficiency. The last chapter presents a summary of the significant findings and important conclusions of the present thesis and the future scope of work.