Abstract

Halide perovskites (HPs) have recently emerged as a new type of inorganic-based semiconductors that are revolutionizing the fields of solar energy conversion and solid-state lighting. In particular, perovskite-based solar cells (PSCs) have experienced a rapid rise in the power conversion efficiency, from 3.8% to 25.2% within a short period of time. Such rapid PSC development has been led by the advances in the understanding and engineering of microstructures of HP semiconductor thin films. In my talk, first, I will look at the fundamental phenomena pertaining to nucleation and grain growth that are involved in the microstructural evolution of HP thin films from their solution-based precursors. Established physical principles that govern these phenomena will be invoked in the context of specific thin-film examples. Based on such understandings, a novel soft chemical process will be demonstrated for upscaling of PSC fabrication. Then, I will discuss the importance of grain-boundary microstructure on the physical properties, chemical stability, and device performance of HPs, and show several rational strategies for tailoring grain-boundary microstructures. Finally, I will present my perspectives on the future directions in the HP research, together with a plan to establish a unique future research program in the broad area of inorganic-based semiconductors for energy/electronic devices.