Title 1: Pre-commercial scale photovoltaic devices on cost-effective and environment-friendly perovskite and kesterite high throughput, better power conversion efficiency, stability, reliability

Brief: Objective is to realize environment-friendly lead-free hybrid perovskite and kesterite solar cells using a) electrochemical deposition, b) hydrothermal route, c) dual ion beam sputtering (DIBS) system, and d) spin coater. A maximum theoretical efficiency in a single junction device is over 30%, achievable by harvesting the ultraviolet to near infrared photons up to 1.1 eV. However, synthesis of stable low-band gap perovskites for efficient light-to-electricity conversion is still a major challenge. Meanwhile, finding ways to create low band gap lead-free perovskites without sacrificing device performance is especially critical since the well-known Pb toxicity hampers the practicality of such perovskite photovoltaics. On the other hand, in order to reduce the manufacturing cost of thin-film kesterite heterojunction based solar cells, new absorber materials, such as Cu2XSn(S,Se)4 (X=Zn, Al, Ge), are being deposited using DIBS and chemical bath deposition (CBD) systems. The targets will be realization of high-performance solar cells on glass, plastic, and stainless steel substrate with high-values of photon conversion efficiency (PCE) and longer device lifetime without commercial-grade device performance degradation.

Keyword: Solar cell, perovskite, kesterite, high power conversion efficiency, cost-effective and environmentally benign