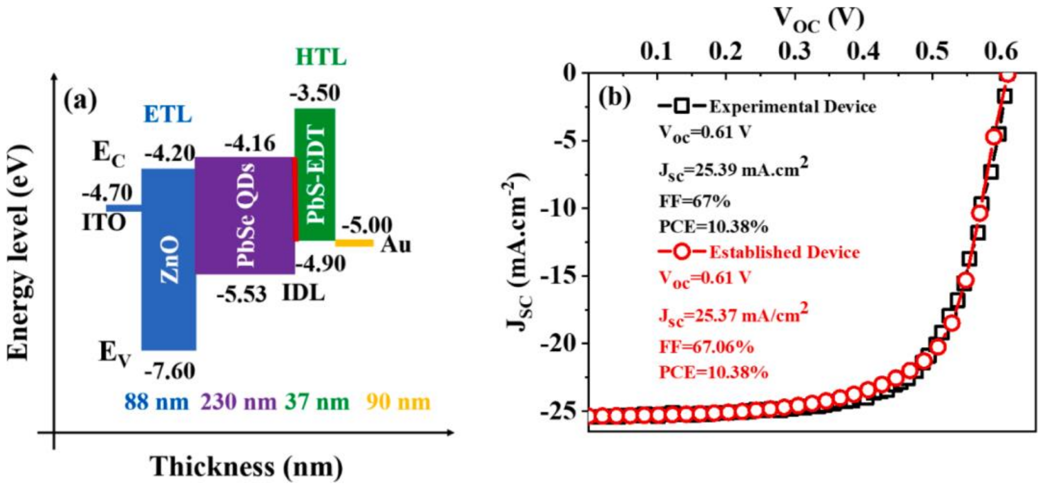
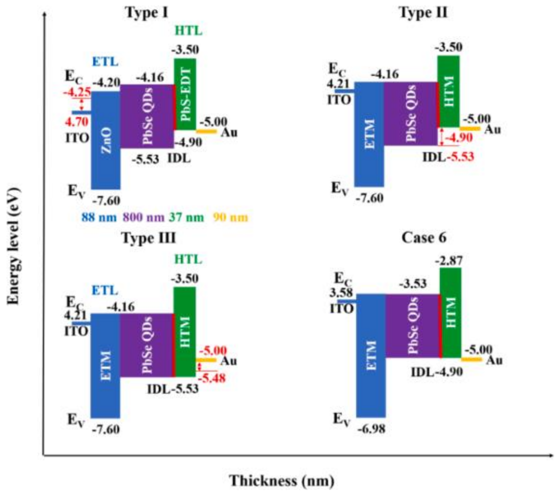
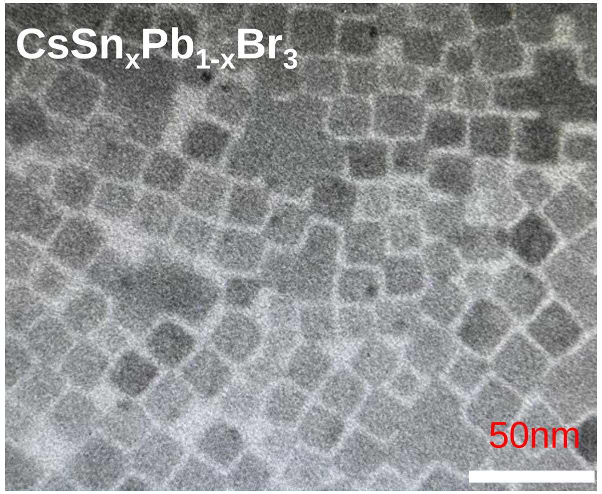
Work 1: The device simulation of PbSe quantum dot solar cells





The performance of Lead selenide quantum dots solar cells (PbSe QDSCs) still lags behind that of c-Si and perovskite solar cells mainly due to **non-radiative** and **resistive losses**. To investigate the limitation of PbSe QDSCs, a theoretical model based on the performance of the state-of-the-art PbSe QDSCs was established through **diffusion-drift theory** and systematically discussed **the optional strategies for optimizing the efficiency of PbSe QDSCs**.

Work 2: Hot carrier cooling mechanisms in tin-lead alloyed perovskite quantum dots



In recent years, perovskite materials have been gained considerable attention in the field of photovoltaics due to their excellent optoelectronic properties, and their cell efficiency has currently surpassed that of monocrystalline silicon cells, which has great commercial prospects. However, perovskite materials contain the heavy metal element, lead, which is highly biologically and environmentally toxic. The utilization of tin element to partially replace or substitute the toxic lead element in perovskite materials and **to enhance the material stability** by preparing it into quantum dot materials to finally prepare environmental-friendly perovskite photovoltaic materials and devices. In addition, tin-based perovskite quantum dots possess the **long-lived hot carrier dynamics**, which are expected to be used to fabricate hot carrier photovoltaics to break the theoretical efficiency limit of conventional solar cells. It is critical to investigate the **internal hot carrier dynamics of tin-based or mixed tin and lead perovskite quantum dots**, including **the enhancement of hot carrier lifetime and the efficient extraction of hot carriers** within the quantum dots. This research has significant implications for the development of next-generation photovoltaic devices.