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Imaging Charge Carrier Transport in Perovskite Thin Films

The functional light-driven materials often exhibit a complex morphology consisting of various grains with short and long-range order and defects stemming from imperfect chemical composition, local strain and etc. Local structural and morphological heterogeneity results in distinct carrier dynamics at different local regions of energy materials. Unfortunately, the conventional spectroscopy techniques reveal only an incomplete picture of the carrier dynamics due to the intrinsic spatially averaged nature of time-resolved techniques. In other words, true structure-function relationships in complex energy materials cannot be reliably probed using conventional time-resolved spectroscopic techniques.

By utilizing time and space resolved technique, i.e., transient absorption microscopy (TAM), we were able to directly monitor local carrier dynamics of spatially heterogeneous systems. In this talk, I will briefly describe the basic operating principle of state-of-the-art ultrafast transient absorption microscopy. I will further discuss recent applications of TAM to thin film hybrid metal halide perovskites. A direct monitoring of ballistic transport of non-equilibrium charge carriers in a series of MAPI perovskite thin film. The effect of energetic disorder in a series of MAPI perovskite thin film. Finally, I will present my recent preliminary but interesting studies on unprecedent exciton dynamics in perovskite thin films and other semiconducting materials.

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