MAR16-2015-000734

Abstract for an Invited Paper
for the MAR16 Meeting of
the American Physical Society

Charge Transport in Hybrid Halide Perovskite Field-Effect Transistors[1]

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Hybrid organic-inorganic trihalide perovskite (HTP) materials exhibit a strong optical absorption, tunable band gap, long carrier lifetimes and fast charge carrier transport. These remarkable properties, coupled with their reduced complexity processing, make the HTPs promising contenders for large scale, low-cost thin film optoelectronic applications. But in spite of the remarkable demonstrations of high performance solar cells, light-emitting diodes and field-effect transistor devices, all of which took place in a very short time period, numerous questions related to the nature and dynamics of the charge carriers and their relation to device performance, stability and reliability still remain. This presentation describes the electrical properties of HTPs evaluated from field-effect transistor measurements. The electrostatic gating of provides an unique platform for the study of intrinsic charge transport in these materials, and, at the same time, expand the use of HTPs towards switching electronic devices, which have not been explored previously. We fabricated FETs on SiO_2 and polymer dielectrics from spin coating, thermal evaporation and spray deposition and compare their properties. $CH_3NH_3PbI_{3-x}Cl_x$ can reach balanced electron and hole mobilities of 10 cm^2/Vs upon tuning the thin-film microstructure, injection and the defect density at the semiconductor/dielectric interface. The work was performed in collaboration with Yaochuan Mei (Wake Forest University), Chuang Zhang, and Z. Valy Vardeny (University of Utah).

[1]The work is supported by ONR grant N00014-15-1-2943.