4CS21-2021-000130

Abstract for an Invited Paper
for the 4CS21 Meeting of
the American Physical Society

Harnessing Hybrid Semi-conductors

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Hybrid organic/inorganic semiconductors (HOIS) offer tremendous opportunities to control fundamental properties that underpin energy technologies. While currently there are enormous worldwide efforts exploring, exploiting and improving a narrow class of HOIS (lead-halide perovskites, such as methylammonium lead iodide), primarily for photovoltaic (PV) applications, there are opportunities to transcend this initial focus on PV research and seek deeper understanding and control of their fundamental properties. Inherent in these unique hybrid systems is the dichotomy between organic/molecular moieties (quantum chemistry) and inorganic/extended systems (solid state physics). As a result, they exhibit properties that are not solely a juxtaposition of the inorganic and organic sub-units, but are instead truly emergent phenomena, with the concomitant ability to control and design new properties by judicious choice of inorganic and organic components. This presentation will touch on efforts to control and manipulate carriers and spin in these HOIS systems. Specifically work controlling carriers and materials chemistry via the creation of 2D-3D interfaces in polycrystalline thin film relevant to a range of optoelectronic devices. Work related to efforts in the Center for Hybrid Organic Inorganic Semiconductors for Energy center to manipulate spin in these systems will also be discussed with focus on efforts to examine controlling recombination for PV or leveraging chiral induced spin selectivity (CISS) for new device concepts will be discussed. Recent developments in how these critical interfaces impact state-of-the-art tandems will likely be discussed.