Constantinos C. Stoumpos
Department of Chemistry
Northwestern University

“Halide Perovskites: Exploring the Materials Chemistry of High Performance Semiconductors”

Abstract: Halide perovskites is an emerging class of high performance semiconductors which operate in the visible and infrared energy range (1.1-3.0 eV). The materials have seen a resurgence in the last 5 years owing to the development of efficient photovoltaic devices, spearheaded by $CH_3NH_3PbI_3$. Starting from the modest 3% in 2009, halide perovskites currently hold a record power-conversion-efficiency of PCE = 22.1%, thus representing the fastest developing solar cell technology known to date. The remarkable physical properties of the halide perovskites stem from their unique electronic structure, which lends the semiconductors high absorption coefficients and charge-carrier mobilities (comparable to III-V semiconductors).

In this talk I will outline the compositional space of the halide perovskites, AMX_3, (A^+ = Cs, CH_3NH_3, $HC(NH_2)_2$); (M^{2+} = Ge, Sn, Pb); (X^- = Cl, Br, I) and explain the structural chemistry of the materials. I will discuss how small changes in the crystal structure can significantly alter the optical, electrical and electronic properties of the perovskites and I will elaborate on how these can be controlled by subtle modifications in their chemical synthesis. I will further describe how these materials can be applied in functional devices, tackling the problems of i) toxicity -by substituting the toxic Pb metal- and of ii) environmental stability -by employing the layered Ruddlesden-Popper perovskites-.