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Hybrid Organic-Inorganic Perovskites: Structural Diversity and Opportunities for Semiconductor Design[1]

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Photovoltaic (PV) devices based on three-dimensional perovskites, (Cs, MA, FA)Pb(I, Br)$_3$ (MA=methylammonium, FA=formamidinium), have attracted substantial recent interest, because of the unprecedented rise in power conversion efficiency to values above 20%, which in turn is made possible by the near ideal band gap, strong optical absorption, high carrier mobilities, long minority carrier lifetimes, and relatively benign defects and grain boundaries for the absorbers. Some of the same properties that render these materials near-ideal for PV, also make them attractive for LED and other optoelectronic applications. Despite the high levels of device performance, the incorporation of the heavy metal lead, coupled with issues of device stability and electrical hysteresis pose challenges for commercializing these exciting technologies. This talk will provide a perspective on and discuss recent advances related to the broader perovskite family, focusing on the extraordinary structural/chemical diversity, including ability to control structural/electronic dimensionality, substitute on the organic cation, metal or halogen sites, and prospects of multi-functionality arising from separately engineered organic/inorganic structural components (e.g., see [1]). Further exploration within this perovskite structural and chemical space offers exciting opportunities for future energy and electronic materials design. [1] B. Saparov and D. B. Mitzi, Chemical Reviews 116, 4558-4596 (2016).

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