Two-Dimensional Organic-Inorganic Hybrid Perovskites: From Edge to Surface

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Abstract: Two-dimensional halide perovskites are exciting new semiconductors that show great promising in low cost and high performance optoelectronics devices including solar cells, LEDs, photodetectors, transistors, *etc*. These materials show great structure and property tunability, not only in the perovskite layer, but also along the 2D crystal edges and surfaces. In the first part of this talk, I will introduce our recent discoveries about the origin and the unique optical and electronic properties of the edge states of the 2D perovskite single crystals. In the second haft, I will present a molecular approach to the synthesis of high-quality organic-inorganic hybrid perovskite quantum wells through incorporating widely tunable organic semiconducting building blocks as the surface capping ligands. By introducing sterically tailored groups into the molecular motif, the strong self-aggregation of the conjugated organic molecules can be suppressed, and single crystalline organic-perovskite hybrid quantum wells and superlattices can be easily obtained via one-step solution-processing. Energy transfer and charge transfer between adjacent organic and inorganic layers are extremely fast and efficient, owing to the atomically-flat interface and ultra-small interlayer distance. Finally, I will briefly talk about the applications of these materials in high performance solar cells and field effect transistors.

Bio: Dr. Letian Dou is currently an assistant professor of chemical engineering at Purdue University. He obtained his B.S. in Chemistry from Peking University in 2009 working with Prof. Xinhua Wan. He then joined Prof. Yang Yang's group in the Department of Materials Science and Engineering at UCLA, and obtained his Ph.D. in 2014 (co-advised by Prof. Fred Wudl @UCSB in 2013). From 2014 to 2017, he was a postdoctoral fellow working with Prof. Peidong Yang at the Department of Chemistry, University of California-Berkeley and Materials Science Division, Lawrence Berkeley National Laboratory. His research interest includes the synthesis of organic-inorganic hybrid materials and low-dimensional materials, fundamental understanding of the optical and electronic properties of these new semiconductor materials, as well as device applications. He is a recipient of Office of Naval Research Young Investigator Award (2019), MIT Technology Review Innovators Under 35-China (2018), R&D100 Award Finalist (2018), MRS Graduate Student Award (2014), and Chinese Government Award for Outstanding Students Abroad (2013). He has published over 40 research papers with more than 10000 citations.