CMP Seminar
Michigan State University

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Electronic Structure and Ultrafast Dynamics at Organic Semiconductor Interfaces – A Path Toward Tailoring Novel Electronic Devices?

Interfaces between organic and inorganic semiconductors have an essential function in many next-generation optoelectronic technologies. Hybrid organic electronic devices combine the ease of tailoring organic semiconductors with the superior electronic properties of inorganic semiconductors to achieve high-efficiency in photovoltaic devices, light-emitting diodes, micro-scale lasers, spin-valves and transistors. Moreover, inorganic semiconductors are used as functional interlayers of complex device architectures in otherwise fully organic devices, where they may prevent unwanted carrier recombination or act as charge-selection layers. Yet, little is known about the principles that determine the emerging electronic structure at such hybrid organic / inorganic semiconductor interfaces, and the microscopic mechanisms and carrier dynamics are unclear.

In this talk, I will discuss the challenge of understanding such interfaces, focusing on the factors that determine their rich physics. Using the prototypical wide-bandgap semiconductor ZnO, I will show how the naturally ultrafast dynamics of carriers in the conduction band are disrupted upon interface formation, and offer a detailed atomistic understanding of the observed localization dynamics. Indeed, I will demonstrate how hybridization between localized states in the inorganic semiconductor and electronic levels of the π-conjugated organic molecule fundamentally determines the interfacial electronic structure and how it is responsible for tailored device function.

In the second part of my talk I will discuss electronic structure and ultrafast dynamics in van der Waals layered (quasi-)2D materials, ranging from topological insulators to semiconductors. These results demonstrate how interfacial hybridization can be chemically controlled, opening new avenues for rational tailoring of electronically active low-dimensional materials.

Monday, November 27, 2017
4:10 p.m.
BPS 1400
Prof. Pengpeng Zhang - Host