**Soft Electronic Materials for Sustainable Energy & Healthcare Applications**

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Soft electronic materials such as organic and organic/inorganic hybrid (e.g. perovskites) semiconductors have attracted a huge interest for sustainable energy and healthcare applications. These applications include photovoltaics, photodetectors, solar fuel, and biosensors. One of the key challenges for the development of these devices is a fundamental understanding of the semiconductor thin films in terms of their structure-property relationship. Although promising, there is still a lack of clear understanding of the impact of molecular structures on photophysical and electrochemical processes, and device structures on interfacial energetics and properties, which are critical for high-performance devices.

In this talk, I will introduce our recent work in three main research areas. First, I will discuss the importance of molecular design on photostability of organic photovoltaic materials with a particular focus on non-fullerene acceptors. I will show how the conjugated backbone planarity, rigidity, and end groups can alter their photostability and hence OPV/OPD device performance. Second, incorporation of glycol side chains into the polymer backbone has been used to improve charge-carrier mobilities in OFETs, reduce exciton binding energies in OPVs, and enhance hydrogen-evolution efficiencies in photocatalysts. However, it is not clearly understood how the glycol sidechains impact polaron formation in the polymer backbone to bring about these improvements. Here I will introduce our recent work on femtosecond stimulated Raman spectroscopy to probe the structural evolution of the polymers upon photoexcitation and charge formation. Finally, I will briefly discuss the importance of interfacial energetics of perovskite solar cells, to understand how the interface between interlayers and perovskite affects photovoltaic device performance.

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