**Surface Photovoltage Characterizations using Kelvin Probe Force Microscopy**

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Transition metal dichalcogenides (TMDs) have been the subject of extensive research for the development of a wide range of optoelectronic devices, including light-emitting devices, quantum emitters, photodetectors, and solar cells, because of their sizable bandgap energies (1-2 eV) and high carrier mobility. The atomically thin physical thickness limits optical absorption and the resulting photo-generated current of the TMD-based devices. These limitations of TMDs can be overcome in various ways. Nanostructures made of semiconductors and metals, for instance, can concentrate incoming light near the surface, either throughout a broad spectrum or at a narrower one. Therefore, the light-matter interaction in TMDs can be considerably improved by integrating 2D TMDs with properly designed 3D nanostructures. The optical response of the 2D materials can be modified in the 2D-3D heterostructures due to strain-induced bandgap modulation and/or charge transfer at the interfaces. However, these electrical influences cannot be thoroughly investigated using only optical characterizations. Surface photovoltage (SPV) signals can reveal the effects of illumination on semiconductors since their sign and magnitude depend on the polarity and density of excess charges. Visualization of the spatial distribution of photo-generated charges in the nanostructures is possible with the help of Kelvin probe force microscopy (KPFM). When trying to understand the KPFM-SPV maps, it is important to take into account not only the charge-transfer along the vertical direction but also the charge drift along the lateral direction at the surface of the sample, especially in 2D TMDs. Complementary researches using optical and SPV techniques shed light on photon-plasmon-exciton connection in 2D-3D multidimensional nanostructures.