Nanoscale Imaging and Coupling of 2D Nanobubbles

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Two-dimensional materials such as transition metal dichalcogenides have promising applications that are based on the tunability of their optical and electronic properties. In particular, the properties of 2D lateral junctions could be used for enhancing the spectroscopic optical signals. We investigated the photoluminescence signals of WSe2, MoSe2 and their lateral heterostructures with nanoscale spatial resolution using the tip-enhanced photoluminescence (TEPL) technique. We studied the nanobubbles formed in heterostructures by nanoindentation as a function of the tip-sample distance. Quantum plasmonic effects based on electron tunneling from the metallic scanning probe tip to the 2D materials and nanobubbles were observed. We also studied the interface between 2D materials and biological systems. The observed tunability and nanoscale control open new possibilities to improve the performance of optoelectronic nanodevices and biosensors.