Nanoscale Imaging and Coupling of 2D Nanoribbons

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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. We investigated the morphological, photoluminescence and Raman signals of WSe_2, $MoSe_2$ and their lateral heterostructures with nanoscale spatial resolution using tip-enhanced scanning probe microscopic techniques. We studied $MoSe_2$ nanoribbons grown on 2D heterostructures by chemical vapor deposition (CVD) as a function of the tip-sample distance. We performed low-frequency TERS measurements of twisted MoSe2 nanoribbons of lateral $MoSe_2$-WSe_2 heterostructures to understand the correlations between the local structural heterogeneities and nano-optical response. Nanoribbons resolution and signal enhancement of low and high frequency modes were compared, and the corresponding enhancement mechanisms were elucidated. These results may be used to design novel quantum optoelectronic nanodevices.