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DIRECT IMAGING OF BAND STRUCTURE FOR CVD GROWN RHOMBOHEDRAL-STACKED BILAYER WSe_2 USING NANOSPOT ANGLE-RESOLVED PHOTOEMISSION

Twisted layers of atomically thin two-dimensional materials support a broad range of novel quantum materials with engineered optical and transport properties[1,2]. Transition metal dichalcogenides (TMDs) in the rhombohedral (3R i.e. 0° twist) crystal phase have been the focus of significant research interest in optical applications due to their particular broken inversion symmetry. Here, we report experimental and theoretical study of WSe_2 homo-bilayers obtained in stable 3R configuration by chemical vapor synthesis[3,4,5,6]. We investigate the electronic and structural properties of these 3R WSe2 bilayers with 3R stacking using micro-Raman spectroscopy, angle-resolved photoemission nano-spectroscopy measurements (nano-ARPES) and Density Functional Theory (DFT) calculations. Our results demonstrate that WSe_2 bilayers with 3R crystal phase (AB stacking) show a significant spin-orbit splitting estimated to 550 ± 20 meV. We derived experimentally effective hole masses of 0.48 me and 0.73 me at K point for upper and lower bands, respectively. Our work opens up new perspectives for the development of optoelectronic and spintronic devices based on 3R TMD homo-bilayers.

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Figures

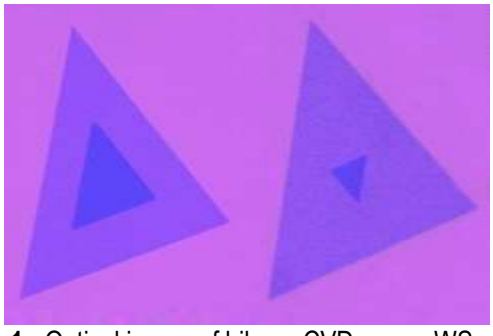

Figure 1: Optical image of bilayer CVD-grown WSe_2 flakes