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Electronic band structure of Two-Dimensional Rhombohedral WSe_2 homobilayers

Twisted layers of atomically thin two-dimensional materials realize a broad range of novel quantum materials with engineered optical and transport phenomena arising from spin and valley degrees of freedom and strong electron correlations in hybridized interlayer bands[1,2]. Here, we report experimental and theoretical studies of WSe_2 homobilayers obtained in stable configurations of 2H (60° twist) and 3R (0° twist) stackings by controlled chemical vapor synthesis of high-quality large-area crystals[3,4,5]. We directly reported the electronic and structural properties of bilayer WSe_2 with the two stacking orders using micro-Photoluminescence (μ-PL) and micro-Raman spectroscopy, angle-resolved photoemission spectroscopy measurements (ARPES), and Density Functional Theory (DFT) calculations. Nano-ARPES clearly demonstrated that our bilayer with AB stacking shows a high spin-orbit coupling of about 500 meV. Our work opens up new perspectives in the development of optoelectronic and spintronic devices made of easily processable TMDs materials.

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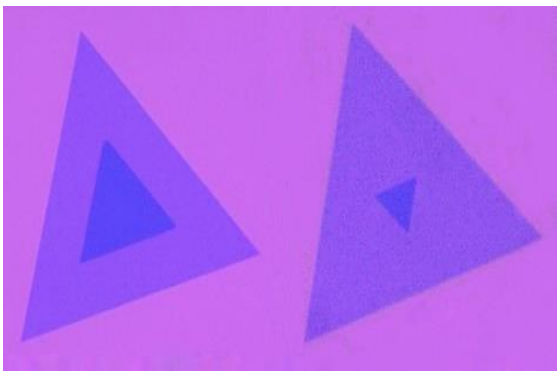

Figure 1: Optical image of CVD-grown WSe_2 bilayer flakes