CVD growth of atomically thin transition metal dichalcogenides and their heterostructures

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Atomic layers of transition metal dichalcogenides (TMDCs) have attracted much attention because of their ultrathin, two-dimensional structures and highly-tunable electronic properties. In the past few years, chemical vapor deposition (CVD) has been widely used as a powerful growth technique to prepare large-area, structure-controlled TMDC samples. This technique also enables the formation of various alloys and heterostructures based on TMDCs. However, there are still several challenges in the growth of TMDC atomic layers, including uniformity, crystallinity, lattice strain, impurities, stability, scalability, and so on. This talk will review the progresses of CVD growth of TMDCs and their heterostructures, and discuss these issues to be solved. We will also present our recent works on the growth of high quality TMDC monolayers with uniform optical spectra on graphite substrates (Fig.1a) [1], and the formation of semiconductor heterojunctions based on MoS_2 and WS_2 atomic layers (Fig.1b,c) [2,3].

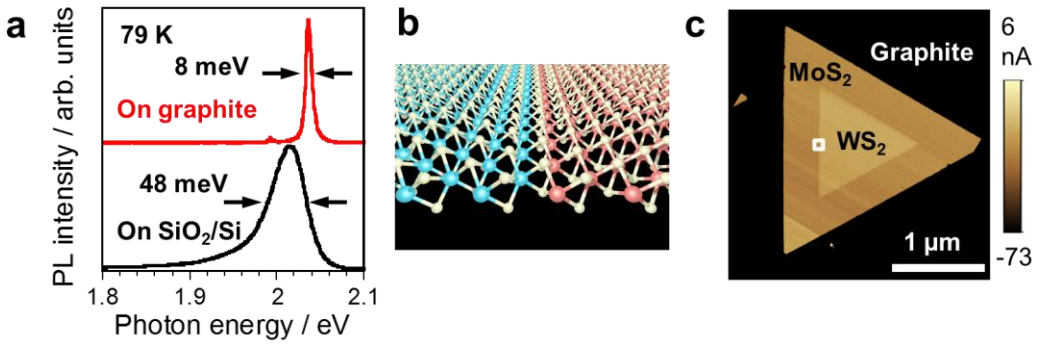

Fig.1 (a) PL spectra of CVD-grown monolayer WS_2 on graphite and SiO_2/Si substrates at 79 K. (b) Structure model and (c) current image of lateral heterostructure of MoS_2 and WS_2 grown on graphite.

[1] Y. Kobayashi *et al.*, ***ACS Nano***, 9, 4056 (2015).
[2] Y. Kobayashi *et al.*, ***Nano Res.***, 8, 3261 (2015).
[3] S. Yoshida, *et al.*, ***Sci. Rep.***, 5, 14808 (2015).