

# 大気圧化学気相合成法による $\text{WS}_2$ 成長に及ぼす $\text{WO}_3$ 前駆体と硫化過程の影響

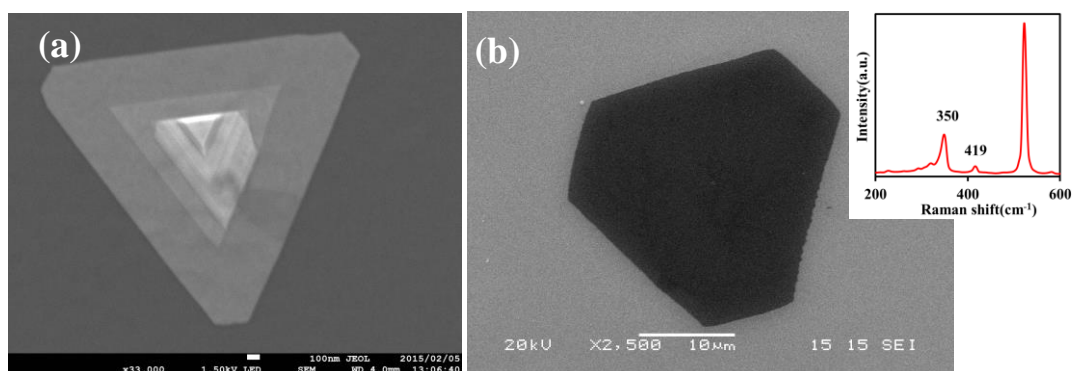
## Effect of $\text{WO}_3$ precursor and sulfurization process on $\text{WS}_2$ crystals growth by atmospheric pressure CVD technique

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Individual monolayers of metal dichalcogenides are atomically thin two-dimensional crystals have attracted significant interest owing to their direct-bandgap property for nano electronics and optoelectronics applications. In this prospect, controllable synthesis of high quality  $\text{WS}_2$  crystals by a chemical vapor deposition (CVD) process is of great importance. Here, we report the effect of sulfurization process and  $\text{WO}_3$  precursor on  $\text{WS}_2$  growth in an atmospheric pressure (AP) CVD. S powder was placed in the center of low temperature furnace and the  $\text{WO}_3$  (2 and 10 mg) powder spread on  $\text{SiO}_2/\text{Si}$  substrate, which was kept in the small ceramic tube and placed in the center of high temperature furnace. S vapor was introduced with Ar flow rate of 80 sccm. Subsequently, the temperature of growth zone ( $\text{SiO}_2/\text{Si}$  substrate with  $\text{WO}_3$  powder) was increased upto  $750^\circ\text{C}$  by the ramping rate  $3^\circ\text{C min}^{-1}$ . The quantity of  $\text{WO}_3$  powder spread on  $\text{SiO}_2/\text{Si}$  substrate significantly affect the nucleation and layer numbers of triangular-shaped  $\text{WS}_2$  crystals. Pyramid-like few-layers stacked structure of  $\text{WS}_2$  crystals are obtained from densely spread  $\text{WO}_3$  powder, whereas larger triangular crystals ( $\sim 70 \mu\text{m}$ ) are obtained by controlling the amount of  $\text{WO}_3$  precursor and rate of sulfurization at  $750^\circ\text{C}$ .



**Fig. 1** FE-SEM image of pyramid like triangular crystal structure (b) SEM image of single triangular  $\text{WS}_2$  crystal (inset of the figure shows Raman spectra of the  $\text{WS}_2$  crystal)

## Reference

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