Location-Selective and One-Step Growth of Dissimilar Transition Metal Dichalcogenide Monolayers

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Abstract

Transition metal dichalcogenides (TMDs), members of two-dimensional (2D) material family, have been demonstrated as promising candidates for future optoelectronic and electronic devices.[1] The success of TMD synthesis by chemical vapor deposition (CVD) is the key to boost up the development of 2D TMD materials.[2] Various TMDs have been successfully synthesized with the similar CVD approach. The growth and formation of vertical or lateral heterojunctions have also been successfully demonstrated. [3,4] However, the scalable approach to control the location of growth is still lacking. In this work, we firstly developed a novel synthetic method to grow more than one TMDs in a single process; meanwhile, the location of each TMD material can precisely controlled. For example, one step CVD growth of WSe_2-$MoSe_2$ PN Junctions along with WSe_2 p-channel and $MoSe_2$ n-channel for CMOS applications are successfully achieved. As a result, the first TMD based inverter using bottom-up approaches has been demonstrated with voltage gain over 6. Detailed CVD processes and device fabrication shall be discussed.

References

[1] H. Li, et al., Nano Energy, 18 (2015), 293
[2] Y.-H. Lee, et al., Adv. Mater., 24 (2012), 2320
[3] X. Duan, et al., Nat. Nanotech., 9 (2014), 1024
[4] M.-Y. Li, et al., Science, 349 (2015), 524

Figures

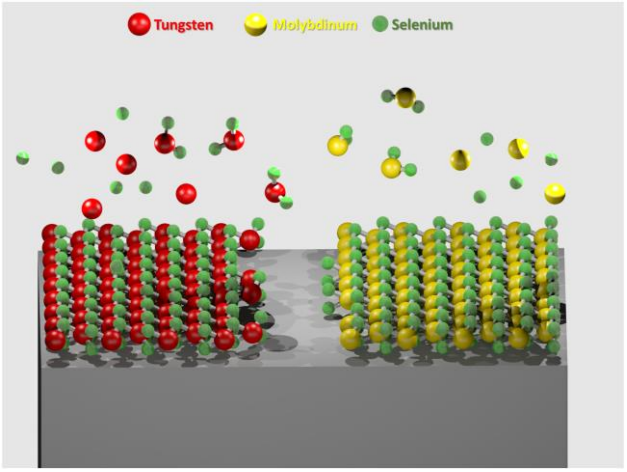

Figure 1: Scheme of location controllable of dissimilar TMDs growth