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Tailored Synthesis and Applications of Two-Dimensional Transition Metal Dichalcogenides Monolayers †

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Abstract: Monolayer transition metal dichalcogenides (TMD) (e.g., MoS_2, WSe_2, $MoSe_2$, WSe_2, $NbSe_2$, etc.) have attracted significant research interest in recent years owing to their unique electronic and optical properties for potential applications in ultrathin device technology. TMD monolayers are available as *n*-type semiconducting ($MoSe_2$, MoS_2, WS_2), *p*-type semiconducting (WSe_2), metallic ($NbSe_2$, NbS_2), and as semi-metallic (WTe_2) materials. To enable the applicability of these ultrathin monolayers, it is essential to develop efficient large-area synthesis techniques. In this talk, I present tailored synthesis of high-quality monolayer TMDs by chemical vapor deposition. The grown TMDs were characterized in detail using complementary characterization tools, including optical microscopy, atomic force microscopy, Raman spectroscopy, and X-ray photoelectron spectroscopy to understand their structural and chemical properties. By performing low-temperature optical spectroscopy, the high optical quality of the CVD-grown monolayers is revealed. The nature of defects and defect density were investigated using high-resolution transmission electron microscopy. The influence of defects in the electronic and optoelectronic properties was investigated using electrical transport measurements and scanning tunneling spectroscopy. Several application possibilities of the CVD-grown TMDs in electronics, optoelectronics, and optics will be discussed.

Keywords: Transition Metal Dichalcogenides; semiconductor; chemical vapor deposition

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Conflicts of Interest

The authors declare no conflict of interest.