Vapor Phase Growth of High Quality Monolayer MoS_2 at Low Temperature

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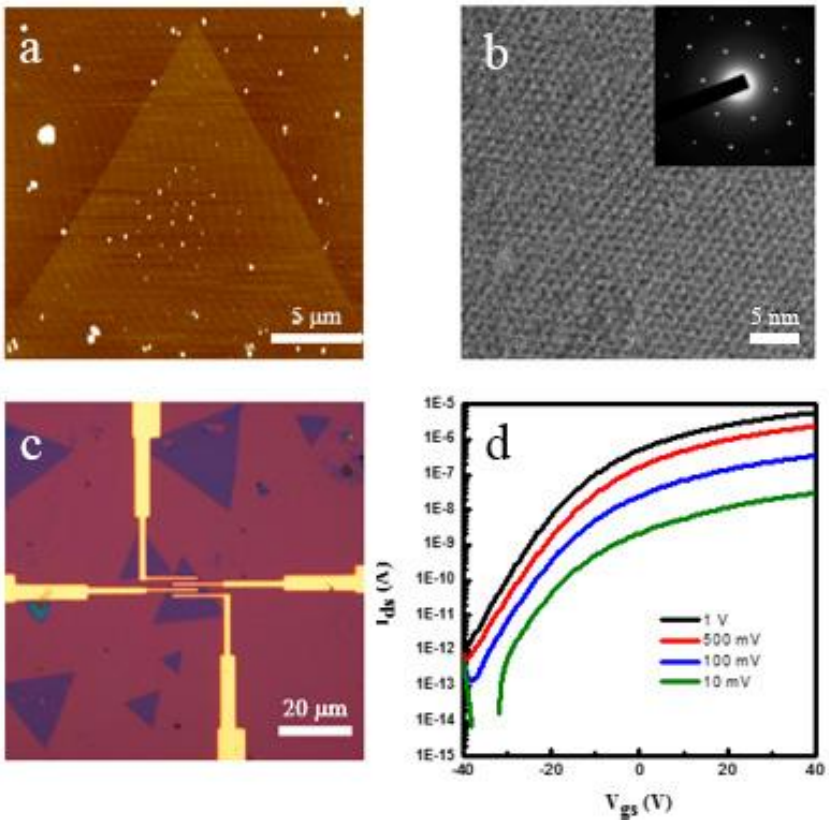
Abstract

Two-dimensional (2D) MoS_2 atomic layer has received extensive attentions due to its outstanding electrical properties and catalysis activity. However, it remains challenging for synthesizing high quality MoS_2 monolayers at temperature lower than 600 ^oC for its applications in nanoelectronic and optoelectronic devices on various substrates. Here, we present a novel strategy for synthesizing monolayered MoS_2 in vapor phase at a growth temperature of 400 ^oC by optimizing the growth parameters. The obtained MoS_2 are mostly monolayered triangular flakes showing high crystallinity with side lengths of ~20 μm. The on/off current ratios and mobility of the field effect transistors (FETs) fabricated on the as made MoS_2 were in the ranges of 10^5−10^6 and 1.0−2.0 $cm^2\ V^{-1}\ s^{-1}$, respectively, comparable with those of backgated FETs made with mechanically exfoliated and chemical vapor deposited MoS_2 flakes. [1, 2] This simple method provides a facile and convenient approach for preparing high quality monolayer MoS_2 and opens up a new way for synthesizing other high quality two-dimensional transition metal dichalcogenides.

References

[1] Wang Q H, S. Strano M, et al. Nature nanotechnology, **11** (2012) 699-712.
[2] Wang X S, Jiao L Y, et al. Journal of the American Chemical Society, **14** (2013) 5304-5307.

Figures



(a) Atomic Force microscope (AFM) image of the as-made MoS_2 flake. (b) High-resolution Transmission electron microscope (TEM) image of MoS_2 and selected area electron diffraction (SAED) patterns taken on a typical area of MoS_2 flakes (inset). (c) Optical image of a back-gated FET with a MoS_2 flake as channel. (d) I_{ds}-V_{gs} curves for the device in (c).