Electronic Supplementary Material (ESI) for Nanoscale.
This journal is © The Royal Society of Chemistry 2018

Supporting Information

Title Metal-Agglomeration-Suppressed Growth of MoS_2 and $MoSe_2$ Films with Small Sulfur and Selenium Molecules for High Mobility Field Effect Transistor Applications

Kwang Hoon Jung, Sun Jin Yun, Yongsuk Choi, Jeong Ho Cho, Jung Wook Lim, Hyun-Jun Chai, Dae-Hyung Cho, Yong-Duck Chung, and Gayoung Kim*

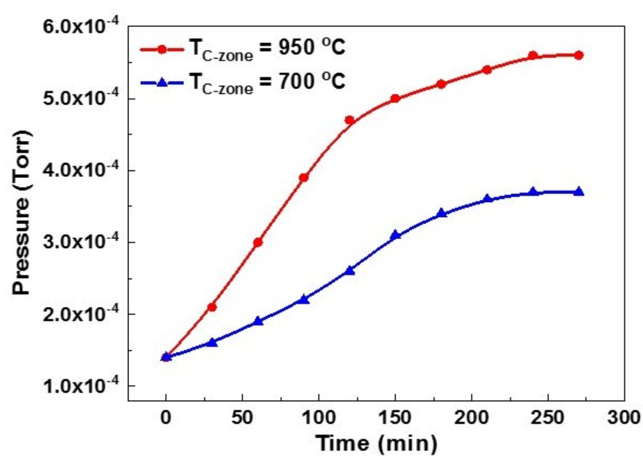

Figure S1. Change in chamber pressure with respect to time at $T_{C\text{-}zone}$ = 700 and 950 °C.

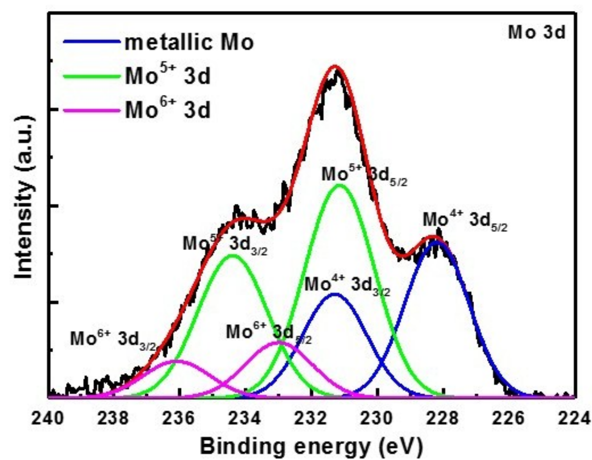

Figure S2. Mo 3d XPS spectrum of Mo film that was deposited to be 2 nm-thick using e-beam evaporation and exposed to air. The component peaks indicate that elemental Mo, oxidized Mo (Mo^{5+} and Mo^{6+}) bonding states coexist in the film. The ratio of different oxidation states of Mo was metallic Mo : Mo^{5+}: Mo^{6+} = 35 : 52 : 13, and the partially oxidized Mo-precursor film was approximately 2.5 nm-thick.

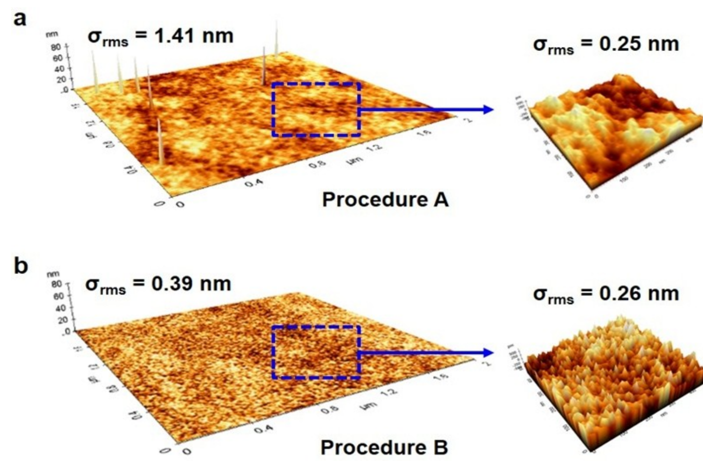

Figure S3. AFM images (2 μm x 2 μm) and rms roughness (σ_{rms}) values of MoS_2 films (T_G=500 ^oC) of (a) procedure A and (b) procedure B. The σ_{rms} value of a region with no protrusions (procedure A) was also compared with that of procedure B in a selected small area (500 nm x 500 nm).

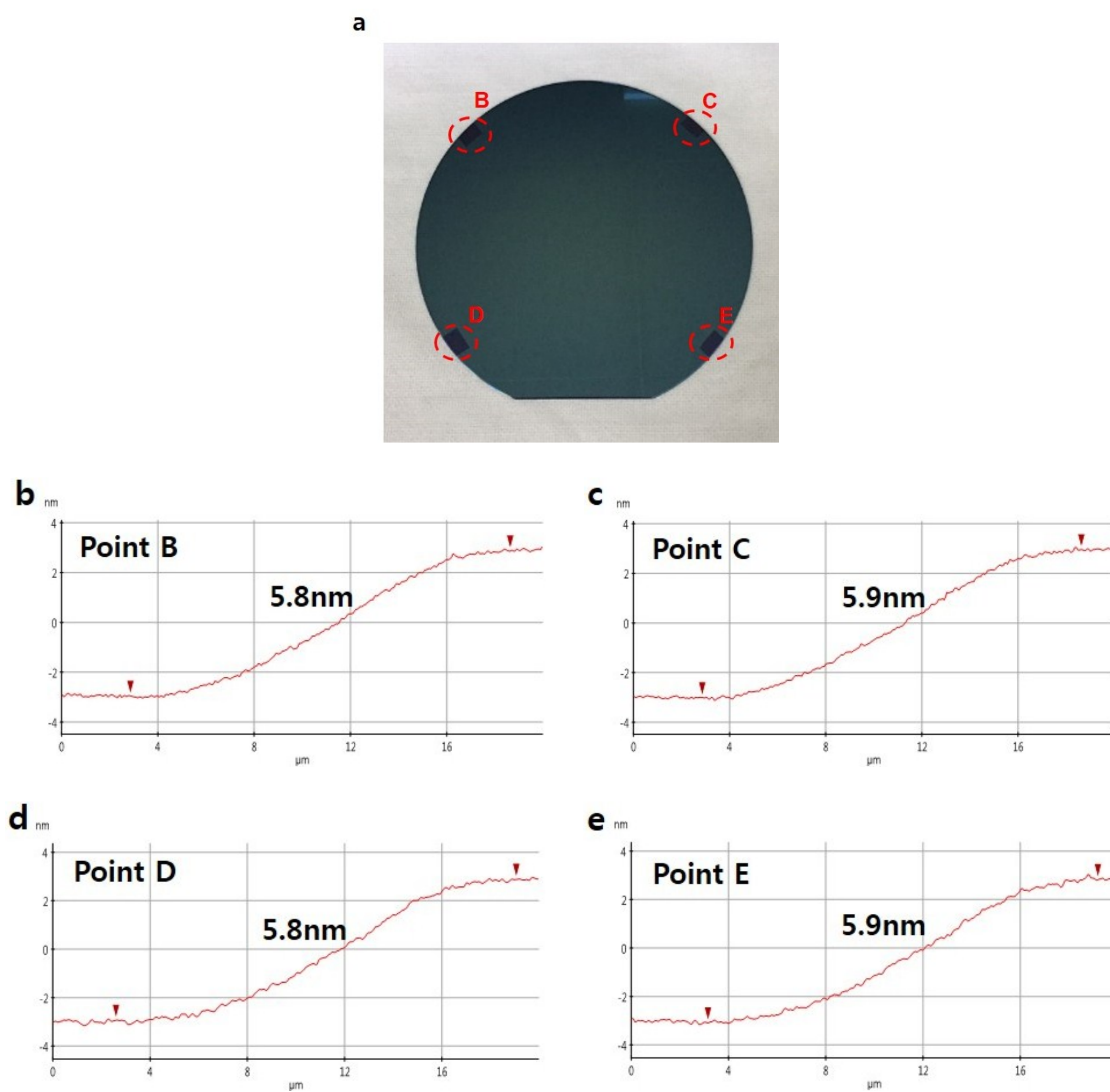

Figure S4. (a) Photograph of a high quality MoS_2 film on a 6 inch SiO_2/Si wafer. Height profiles of the MoS_2 film at points (b) B, (c) C, (d) D, and (e) E.

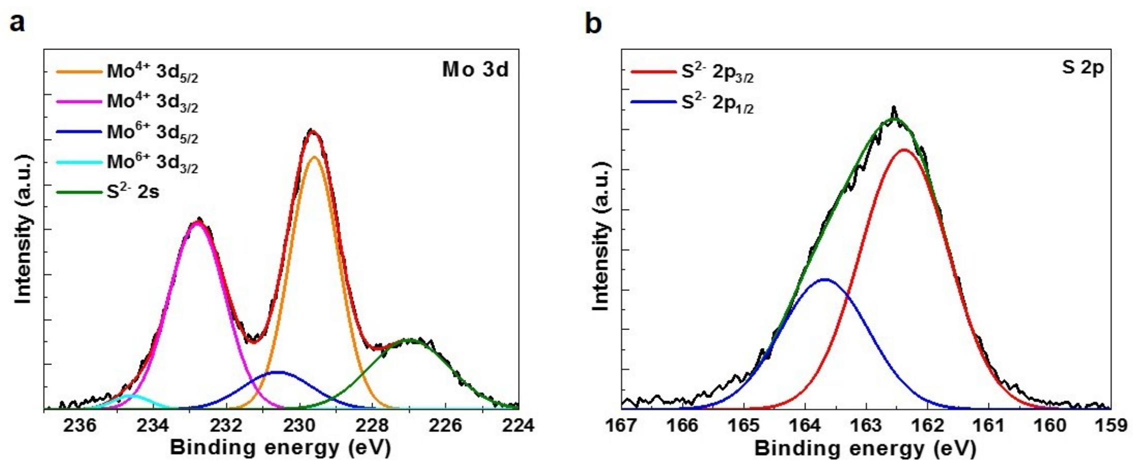

Figure S5. XPS peaks of (a) Mo and (b) S in a 6 nm-thick MoS_2 film fabricated at $T_{R\text{-}zone}$ = 120 °C.

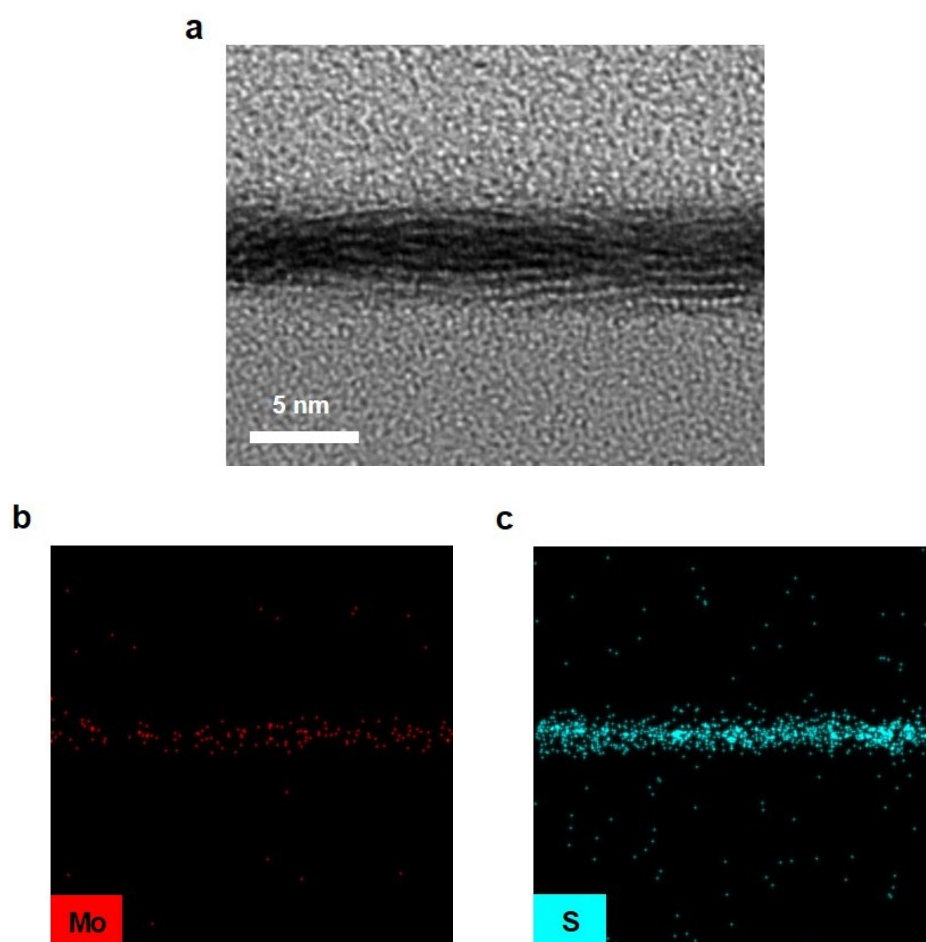

Figure S6. (a) A cross-sectional TEM image of a 3.1 nm-thick MoS_2 film. EDS maps of (b) Mo and (c) S in a 3.1 nm-thick MoS_2 film.

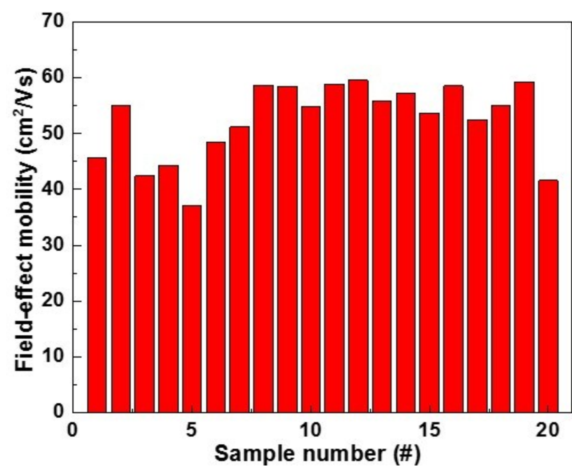

Figure S7. Histogram of field-effect mobility of MoS_2-FETs for 20 devices fabricated on a substrate.