Supplementary Information

Promotion of Mo-based ionic crystal precursor for MoS_2 wafer growth

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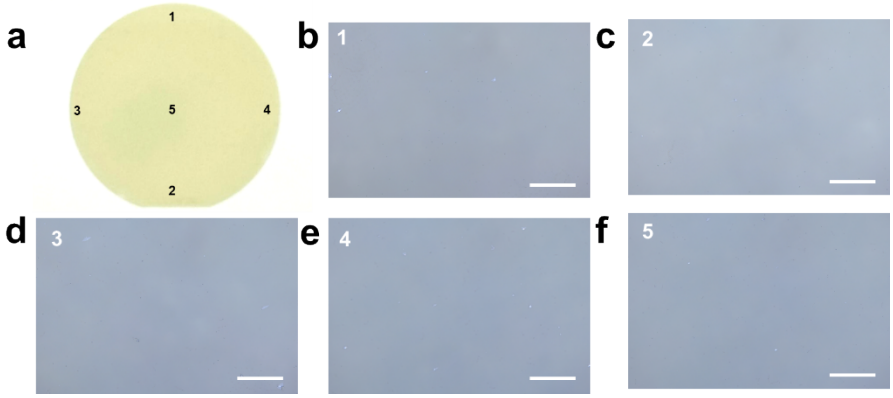

Figure S1 (a) The optical image of the 2-inch MoS_2 film grown using Na_2MoO_4. (b-f) The optical image was measured evenly at 5 locations on a 2-inch wafer. The scale bar is 100 μm.

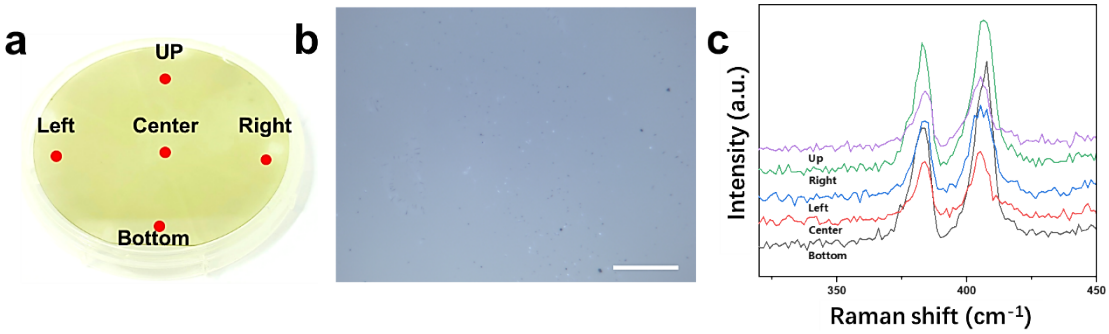

Figure S2 $(NH_4)_2MoO_4$ as ion precursor has been adopted to grow wafer-scale MoS_2 film. (a) The photo of the 2-inch MoS_2 film grown using $(NH_4)_2MoO_4$. (b) The optical image of wafer-scale MoS_2 films using $(NH_4)_2MoO_4$ show high continuity and uniformity. The scale bar is 100 μm. (c) Raman spectra of MoS_2 using $(NH_4)_2MoO_4$ could also reflect the uniformity show in different marks shown in Figure S2a.

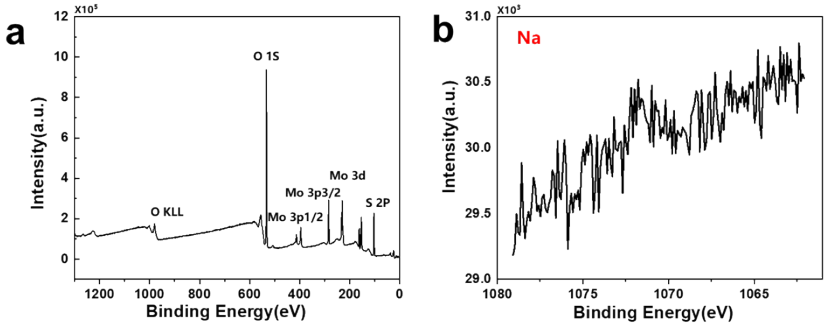

Figure S3 (a) XPS survey spectrum and (b) high-resolution Na 1s XPS spectra of MoS_2 using Na_2MoO_4

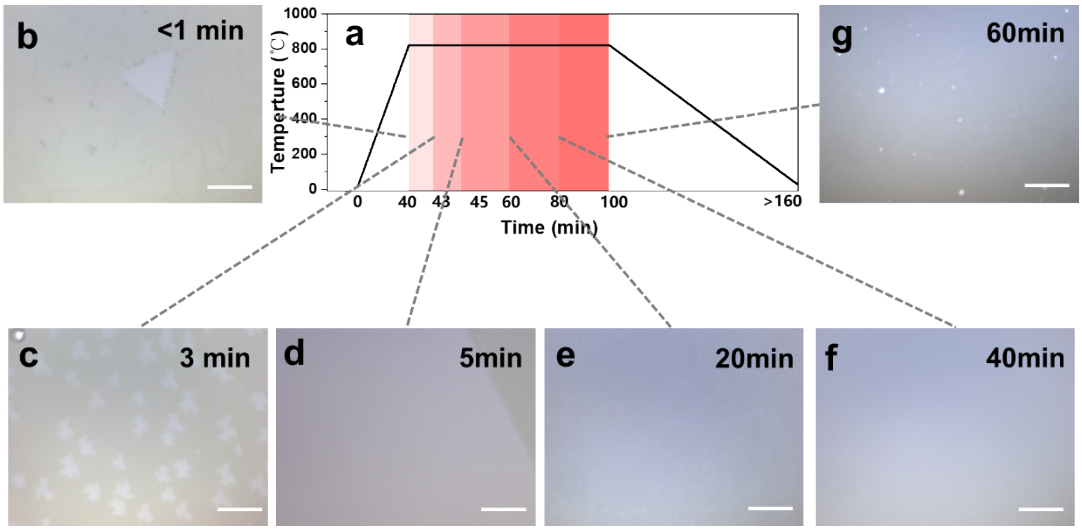

Figure S4 The temperature-time (T-t) curve (black) and different growth time interval (filled in red) in wafer-scale MoS_2 growth. In the early stage of growth is a linear heating stage, molybdenum source and sulfur source remain inert. After 800℃ insulation, molybdenum source and sulfur source began to be active. Rapid growth happens at the holding temperature. Finally, the chamber naturally cools to room temperature. the scale bar is 20 μm in Figure S1(b-g) optical images .

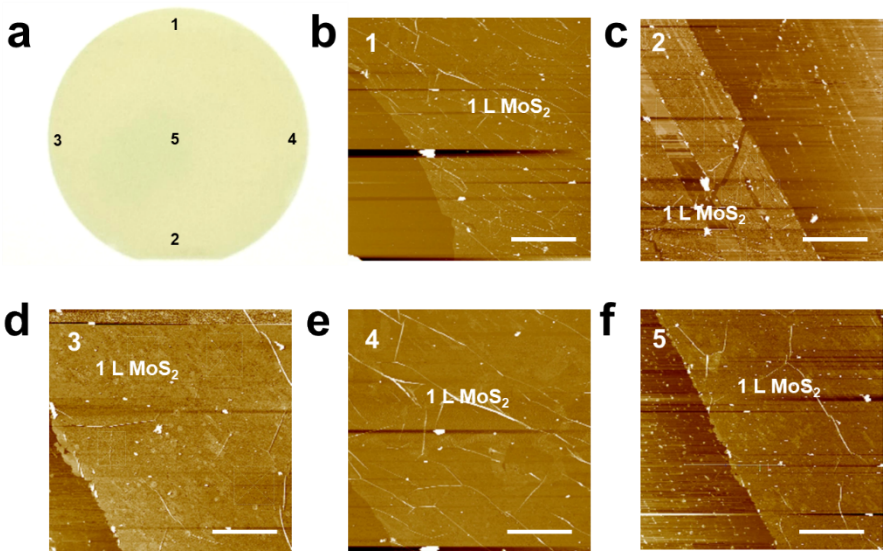

Figure S5 AFM images of monolayer MoS_2 wafer in different areas. (a) The optical image of the 2-inch MoS_2 film grown using Na_2MoO_4. (b-f) The AFM image was measured evenly at 5 locations on a 2-inch wafer. The scale bar is 2 μm.

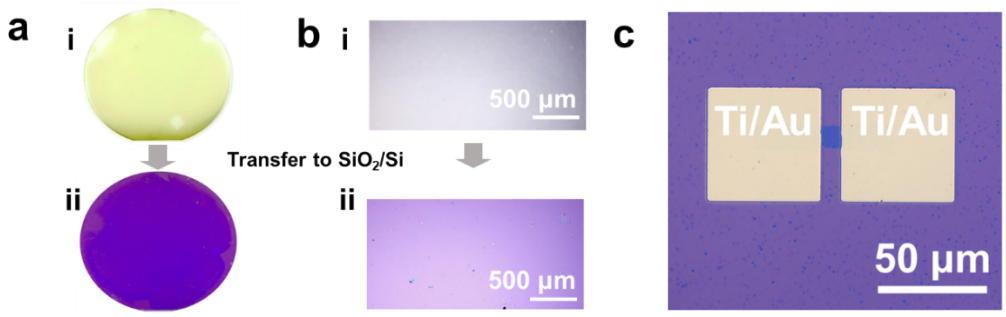

Figure S6 Transfer and device fabrication of wafer-scale monolayer MoS_2. (a) 2-inch wafer MoS_2 on sapphire (Figure S3a(i)) has been transferred to 285 nm SiO_2/Si in Fig S3a(ii). (b) the optical images of MoS_2 are shown in the Figure 3b. (c) the source and drain electrodes (Ti/Au, 20/30 nm) were defined on MoS_2 by photolithography, electron-beam evaporation and vacuum metallization for smaller ohmic contact resistance.