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## Monolayer MoS<sub>2</sub> Growth at Metal-Insulator Interface

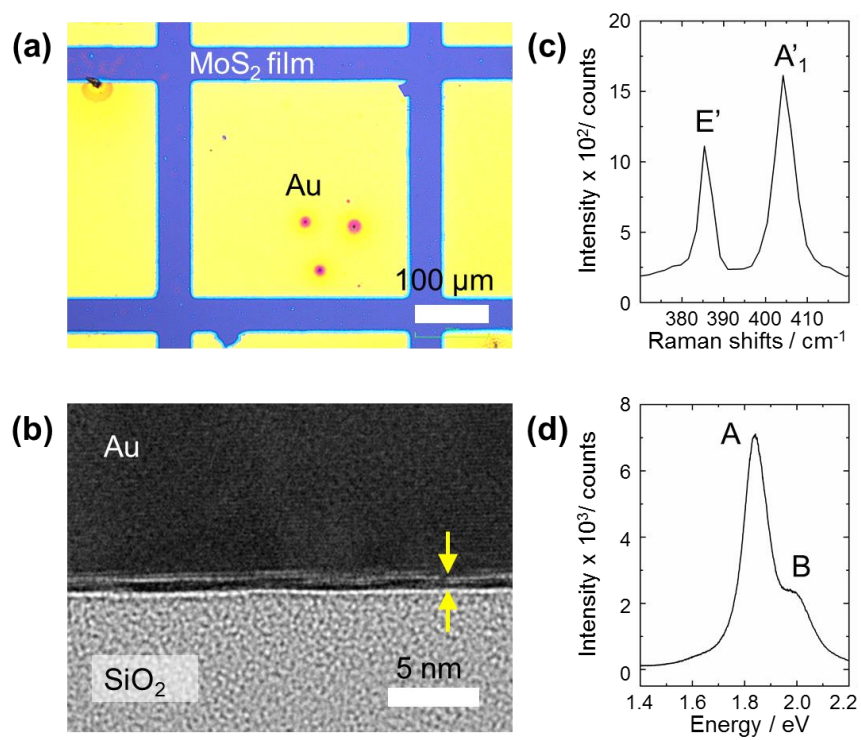
Transition metal dichalcogenides (TMDs), MX<sub>2</sub> (M= Mo, W and X= S, Se), are getting popular these days for their unique electronic and optoelectronic properties shown when thinned. [1, 2] Apart from the exfoliation technique used, monolayers of TMDs are usually synthesized on surfaces of different substrates such as silicon dioxide, gold and graphite. While this approach allows a large area growth of high quality TMD sheets, the materials prepared are succumbed to potential threats of rapid degradation and contamination under ambient condition or during device fabrication. [3-5]

Herein, we demonstrate an unconventional growth of MoS<sub>2</sub>, where the monolayer sheets are generated at the interface between gold and silicon oxide by using alkali halide-assisted chemical vapor deposition (CVD) method. [6, 7] The MoS<sub>2</sub> sheet was observed using cross-sectional transmission electron microscope (TEM) and characterized using optical measurements (Figure 1). Its signature Raman peaks are observed at 385 and 405 cm<sup>-1</sup> for the E' and A'<sub>1</sub> peaks, respectively. Meanwhile, the A and B excitons, are recorded at 1.8 and 2.0 eV, similar to those exfoliated monolayer sample. Raman and photoluminescence mapping results indicate that the MoS<sub>2</sub> produced is highly uniformed in terms of crystal and optical qualities. The MoS<sub>2</sub> sheet is speculated to form via an interface diffusion mechanism. Monolayer grains were found to nucleate progressively from the boundary edge moving towards the center beneath the deposited gold, which then merged into a connected network as reaction proceeds. By programming the design of the gold pattern, we could manipulate the MoS<sub>2</sub> growth over a specific site with desirable geometry to form the field effect transistor (FET). Since the MoS<sub>2</sub> is directly grown at the interface, this significantly reduces the chance of exposure to the harmful adsorbates, and hence enables clean contact interface with the metal. Our results enlighten not only on the unprecedented growth of the TMDs at bulk solid interface, but also their simultaneous integration into nanodevices.

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**Figure**



**Figure 1:** (a) Optical micrograph and (b) cross-sectional TEM image of the sample obtained after CVD. Layered structure is observed at the interface between Au and SiO<sub>2</sub>. (c) Raman and (d) PL spectra recorded for the sample grown at the interface.