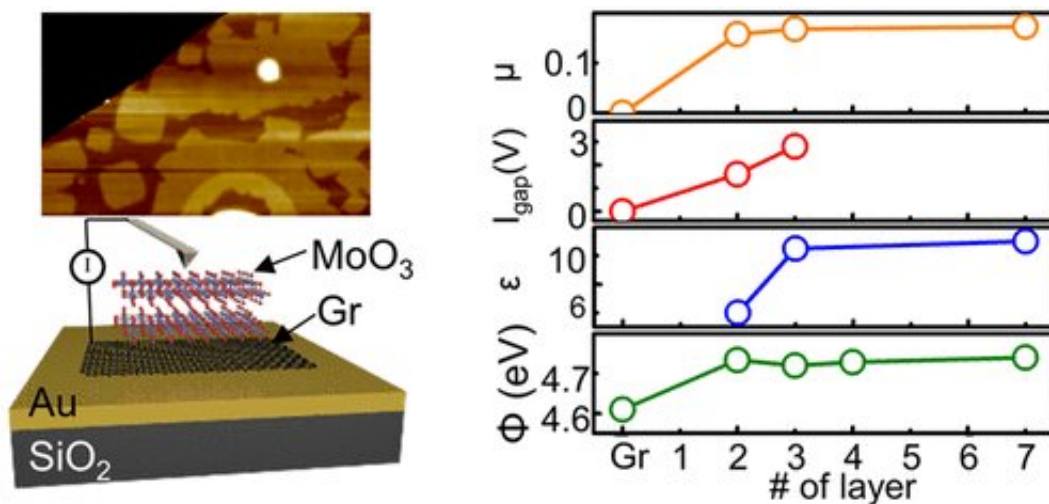


# Epitaxially-grown molybdenum oxide advances as a bulk-like 2-D dielectric layer

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Credit: Seoul National University

Since the successful isolation of graphene from bulk graphite, remarkable properties of graphene have attracted many scientists to the brand-new research field of 2-D materials. However, despite excellent carrier mobility of graphene, direct application of graphene to field-effect transistors is severely hindered due to its gapless band structure. Alternatively, semiconducting transition metal dichalcogenides (TMDCs) have been focused intensively over the last decade. However, wide bandgap 2-D materials with  $> 3$  eV have been required for UV-related optoelectronic devices, power electronics, and dielectric layers.

One of promising candidates is [transition metal oxides](#) (TMOs), which have a large bandgap, structural diversity, and tunable physical/chemical characteristics. Nevertheless, the scalable growth of atomically-thin TMOs remains challenging until now since it is very prone to lattice-mismatch strain and strong substrate clamping during growth.

Recently, the research team led by Prof. Gwan-Hyung Lee of Seoul National University overcame the issue by employing the van der Waals (vdW) epitaxial growth method. The research team reported a novel method for scalable growth of orthorhombic molybdenum oxide( $\alpha$ -MoO<sub>3</sub>) nanosheets on the graphene substrate. An important question in this work is what the effect of thickness on the electrical and [physical properties](#) is. To figure out this, comprehensive atomic force microscopy (AFM) studies were performed to explore structural and electrical properties of MoO<sub>3</sub> layers with various thickness.

Interestingly, AFM study revealed that MoO<sub>3</sub> nanosheets retain bulk-like structural and electrical properties even when MoO<sub>3</sub> nanosheets are thicker than 2 - 3 layers (1.4 - 2.1 nm in thickness).

Particularly, the thickness-sensitivity of friction is very small compared to other hexagonal 2-D materials. This intriguing result is attributed to the doubled octahedral planes of monolayer MoO<sub>3</sub> with exceptionally small interatomic separation. Additionally, work function and dielectric constant are also thickness-independent, along with invariant electronic band structure regardless of the thickness. Besides, the team showed that MoO<sub>3</sub> nanosheets obtain a large current gap and high [dielectric constant](#), emphasizing that MoO<sub>3</sub> can be used as promising 2-D dielectric materials.

**More information:** Jong Hun Kim et al, Thickness-Insensitive Properties of  $\alpha$ -MoO<sub>3</sub> Nanosheets by Weak Interlayer Coupling, *Nano Letters* (2019). [DOI: 10.1021/acs.nanolett.9b03701](https://doi.org/10.1021/acs.nanolett.9b03701)

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