

The Properties of 2D Materials on Functional Oxides

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As intriguing characteristics of two-dimensional (2D) materials including MoS₂, ReSe₂ and other transition metal dichalcogenides (TMDs) have been studied, the combination of 2D materials with various functional materials is attracting attention. Especially, high- κ dielectric or ferroelectric materials have been considered as promising candidates to study synergetic effects when integrated with 2D materials. Specifically, SrTiO₃ (STO) thin film can be used to aid at improving the performance of graphene device. We are interested in the properties of few-layer ReSe₂ and MoS₂ nanosheets or field effect transistor (FET) device on the functional oxides such as STO thin film or BiFeO₃ (BFO) nanodot array which attract much attention because of their potential applications to nanoscale devices required for the next-generation semiconductor industry. We made BFO nanodot arrays with 70nm in diameter on SrRuO₃ (SRO) /SrTiO₃ (STO) using porous anodic aluminum oxide (AAO) template and STO/Nb:STO thin film by pulsed laser deposition (PLD). And then we performed atomic force microscope (AFM), high resolution x-ray diffraction (HR-XRD) measurements for nanodot array and thin film. We also performed AFM and Raman spectroscopy for ReSe₂ and MoS₂ nanosheet to investigate their properties. We fabricated FET devices of TMDs using e-beam lithography and evaporator system and measured the electrical property of them. We are going to make the junction devices between TMDs and oxides by transfer method and investigate effects of oxides to their electrical and optical properties. For this, we will compare the experimental data with the simulation results.

References

- [1] Jeongmin Park, Nano Lett. 16, 1754–1759 (2016)
- [2] F. Schwierz, Nature Nanotech 5, 487-496 (2010)

Figures

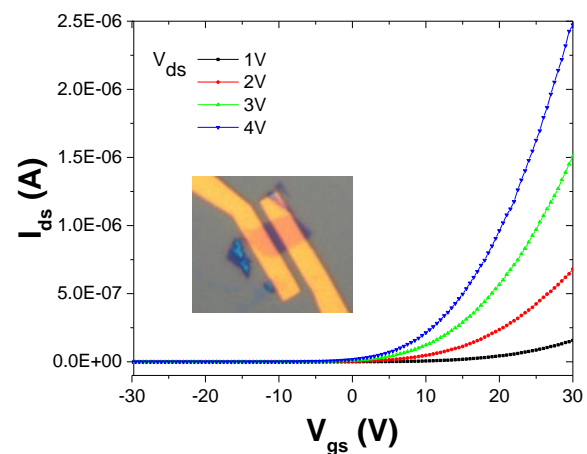


Figure 1. Transfer characteristics of few-layer ReSe₂ FET and optical image of device.

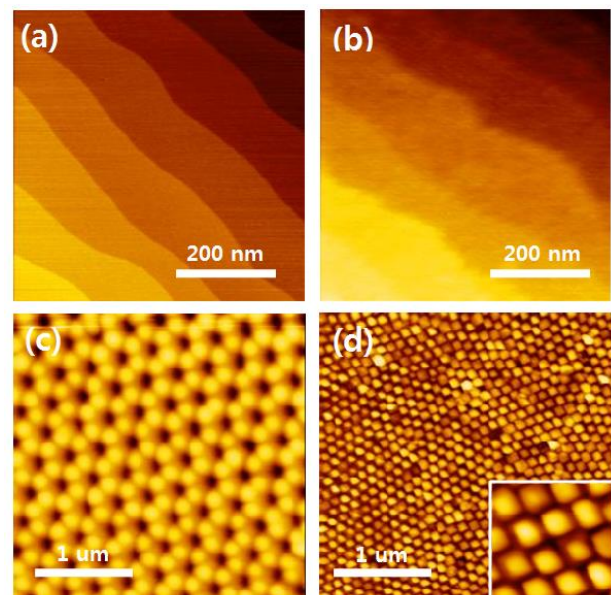


Figure 2. AFM topography images of oxides. (a) Nb:STO substrate which has terraces with smooth step edges. (b) STO thin film. (c) AAO template. (d) BFO nanodot array.