ヘテロ構造原子膜半導体

Atomically thin hetero-structural semiconductors

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Transition metal dichalcogenides (TMDs) with the common formula MX_2, where M stands for a transition metal from group IV-VII (M = Mo, W, Nb, Re, and so on) and X is a chalcogen element (S, Se, Te), is a well-known class of layered composite materials. Using atomic-scale thin film of metal dichalcogenides layered material, we have developed semiconducting channel for future electronics. We investigated optical properties and transport properties, particularly scattering property of carrier transport in field effect transistors (FETs). In this transport experiment, we characterized one of the important properties of the TMDs for electronics.

A long-standing puzzle is the low carrier mobility (μ) in them as compared with corresponding bulk structures, which constitutes the main hurdle for realizing high-performance FETs. To address this issue, we perform a combined experimental and theoretical study on atomically thin MoS_2 FETs with varying the number of MoS_2 layers (NLs). Furthermore, we fabricated a field effect transistor with a novel combination of graphene and nano-sheet to realize atomically thin film hetero-structure. For further direct formation of semiconductor and dielectric based on atomically thin film, we also developed layer-by layer oxidation process in WSe_2 layers.

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References

[1] S.-L. Li, et al., Nano Letters 13, 3546 (2013).

[2] W.-W. Li, et al. Applied Physics Letters 103, 023113 (2013).

[3] M.Yamamoto, et al., ACS nano 8, 3895 (2014).

[4] M.Yamamoto, et al, Nano Letters 15, 2067 (2015).