Top-gatedMoS$_2$ field-effect transistor with ultra-thin HfO$_2$ gate dielectric formedby Hf-seeded atomic layer deposition

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The fabrication of high-performance top-gated MoS$_2$field-effect transistors (FETs) requires uniform deposition of an ultra-thin gatedielectric film with a high dielectric constant (high-k) on the MoS$_2$ channel layer. However, the chemicallyinert basal planes of two-dimensional MoS$_2$ prevent sufficient chemisorptionof atomic layer deposition (ALD) precursors needed for the uniform high-k film deposition. As one of approachesfor functionalization of the MoS$_2$ surface, various seeding layers havebeen introduced prior to the high-kALD [1]. In this presentation, we fabricated and evaluated the top-gated MoS$_2$FETs with ultra-thin HfO$_2$ gate dielectric films without pin-holes,which were formed by ALD at 250 °C after introducing an e-beam evaporated Hfseed layer. The surface coverage of the HfO$_2$ films on themechanically-exfoliated MoS$_2$ films was investigated using variousmicroscopic tools. In addition, the possible side effects of the Hf seed layeron MoS$_2$ were examined. Lastly, the top-gated MoS$_2$ FETs withan Hf-seeded HfO$_2$ film (~5 nm) were fabricated and theircharacteristics were compared with those with a thick HfO$_2$ film (~30nm) without a seeding layer.