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High-k Dielectric Nanosheets for Two-Dimensional material Electronics YUFENG HAO, XU CUI, JUN YIN, GWAN-HYOUNG LEE, GHIDEWON AREFE, columbia university, MINORU OSADA, TAKAYOSHI SASAKI, NIMS, Japan, JAMES HONE, Columbia University — Two-dimensional (2D) materials, such as graphene, hexagonal boron nitride (hBN), transition metal dichalcogenides, have shown great potential in nano-electronics because of their unique and superior physical properties. Among them, hBN has been known as an alternative dielectric that is atomically flat and free of trapped charges, which drastically enhance the mobility of graphene or MoS2. However, low dielectric constant (k $\sim$ 3.5) of hBN limits its use in transistors as gate lengths are scaled down to tens of nanometers. Here we demonstrate high performance graphene and MoS2 field effect transistors by using ultrathin Ca2NaNb4O13 nanosheet as a dielectric and mechanically stacking 2D materials. We developed a facile transfer strategy to build 2D materials devices based on the Ca2NaNb4O13 nanosheets. We measured and found that the oxide nanosheet has high dielectric strength, along with high dielectric constant at thickness of a few tens of nanometer. Therefore, multiple-stacked heterostructure of 2D materials shows high mobility at small operating voltage. This study shows possibility of high-k dielectric nanosheets for 2D electronics.

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