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Ferroelectric memory based on molybdenum disulfide and ferroelectric hafnium oxide WUI CHUNG YAP, University of Illinois - Urbana Champaign, HAO JIANG, QIANGFEI XIA, University of Massachusetts Amherst, WENJUAN ZHU, University of Illinois - Urbana Champaign — Recently, ferroelectric hafnium oxide (HfO_2) was discovered as a new type of ferroelectric material with the advantages of high coercive field, excellent scalability (down to 2.5 nm), and good compatibility with CMOS processing. In this work, we demonstrate, for the first time, 2D ferroelectric memories with molybdenum disulfide (MoS_2) as the channel material and aluminum doped HfO_2 as the ferroelectric gate dielectric. A 16 nm thick layer of HfO_2, doped with 5.26% aluminum, was deposited via atomic layer deposition (ALD), then subjected to rapid thermal annealing (RTA) at 1000 C, and the polarization-voltage characteristics of the resulting metal-ferroelectric-metal (MFM) capacitors were measured, showing a remnant polarization of ~0.6 $\mu C/cm^2$. Ferroelectric memories with embedded ferroelectric hafnium oxide stacks and monolayer MoS_2 were fabricated. The transfer characteristics after program and erase pulses revealed a clear ferroelectric memory window. In addition, endurance (up to 10,000 cycles) of the devices were tested and effects associated with ferroelectric materials, such as the wake-up effect and polarization fatigue, were observed. This research can potentially lead to advances of 2D materials in low-power logic and memory applications.

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