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Graphene – ferroelectric and MoS2 – ferroelectric heterostructures for memory applications. ALEXEY LIPATOV, PANKAJ SHARMA, ALEXEI GRUVERMAN, ALEXANDER SINITSKII, University of Nebraska - Lincoln — In recent years there has been an unprecedented interest in two-dimensional (2D) materials with unique physical and chemical properties that cannot be found in their three-dimensional (3D) counterparts. One of the important advantages of 2D materials is that they can be easily integrated with other 2D materials and functional films, resulting in multilayered structures with new properties. We fabricated and tested electronic and memory properties of field-effect transistors (FETs) based on a single-layer graphene combined with lead zirconium titanate (PZT) substrate. Previously studied graphene-PZT devices exhibited an unusual electronic behavior such as clockwise hysteresis of electronic transport, in contradiction with counterclockwise polarization dependence of PZT. We investigated how the interplay of polarization and interfacial phenomena affects the electronic behavior and memory characteristics of graphene-PZT FETs, explain the origin of unusual clockwise hysteresis and experimentally demonstrate a reversed polarization-dependent hysteresis of electronic transport. In addition we fabricated and tested properties of MoS2-PZT FETs which exhibit a large hysteresis of electronic transport with high ON/OFF ratios. We demonstrate that MoS2-PZT memories have a number of advantages over commercial FeRAMs, such as nondestructive data readout, low operation voltage, wide memory window and the possibility to write and erase them both electrically and optically.

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