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Novel Resistive Switching in MgO with Nitrogen Doping CHENG-HAN YANG, Stanford University, XIN JIANG, MAHESH SAMANT, BRIAN HUGHES, LI GAO, ANDREW KELLOCK, STUART PARKIN, IBM Almaden Research Center — Resistive switching in oxide thin films has been extensively explored as a candidate for the next generation nonvolatile memory. The oxide layer is formed from a dielectric material, normally insulating oxides or wide-bandgap semiconductors. The mechanisms of the resistive switching have been proposed to be the formation of a conducting filament by defect drift or metal migration. However, there is no experimental observation of such a switching in the alkali earth metal oxide due to its strong ionic bonding which leads to a relatively low concentration of natural defects such as oxygen vacancies. In this report, we demonstrate resistive switching in Nitrogen doped MgO. The ratio of the resistance change in N-doped MgO can be varied between 1-4 orders of magnitude by varying the nitrogen content by just a few percent. The measured RESET current is as low as few tenths of μA indicating a low power consuming device. We also demonstrate an ultra-fast switching with use of SET/RESET voltage pulses in the range of 1ns/100ns. Moreover, we show that multi-level resistance switching can also be achieved by controlling the nitrogen doping level and/or the RESET voltage.

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