Electric-field-induced writing of perpendicular magnetic tunnel junctions (MTJs) based on Ta/CoFeB/MgO/CoFeB/Ta structures has shown great promise for high-density and energy-efficient embedded Magnetoelectric Random Access Memory (MeRAM) applications. [1-2] The electric-field- or voltage-induced magnetization switching exploits the effect of voltage-controlled magnetic anisotropy (VCMA) to temporarily lower the energy barrier during write operation, thus drastically reducing the write energy compared with current-controlled mechanisms such as spin transfer torque and spin-orbit torque.

In this poster, we first present results that the write efficiency, i.e. VCMA coefficient, of the MTJs is enhanced by 40% by integrating an ultra-thin PZT film with high dielectric constant into the MgO tunnel barrier. The MTJs with the MgO/PZT/MgO barrier fabricated via a combination of sputtering and atomic layer deposition techniques also possess a sizeable tunneling magnetoresistance (TMR) of more than 50% at room temperature. [3]

However, in order to integrate the MeRAM as an embedded memory into advanced CMOS back-end-of-line processes, perpendicular magnetic anisotropy (PMA) and VCMA must be sustained when annealing temperatures above 400°C are used. We will then present results on Mo/CoFeB/MgO-based structures where PMA and VCMA can be sustained at annealing temperature as high as 430°C. The PMA and VCMA both increase with higher annealing temperature and a VCMA coefficient of more than 50 fJ/(V-m) is demonstrated at 430°C. [4]

Keywords: magnetic tunnel junction, voltage-controlled magnetic anisotropy, thermal stress stability

References:


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