Low dc leakage Cr$_2$O$_3$ thin films towards milli-volt switching of exchange bias

SALINPORN KITTIWATANAKUL, YUHAN WANG, University of Virginia, CONGLI SUN, PAUL VOYLES, University of Wisconsin-Madison, JIWEI LU, University of Virginia — Reactive bias target ion beam deposition (RBTIBD) was used to synthesize single phase highly textured antiferromagnetic Cr$_2$O$_3$ on Pt/sapphire substrate. The as-deposited substrate temperature and oxygen flow rate were explored to optimize the phase, crystallinity, and surface morphology of the Cr$_2$O$_3$ thin films with Neel temperature of 300 K. A very low electric leakage (3E-5 A/cm$^2$) in single-phase chromia films less than 10 nm thick was observed. Dielectric permittivity and loss were measured as a function of film thickness. These new results demonstrate the potential of milli-volt switching voltage for exchange bias of magnetic structures using antiferromagnetic chromia, for practical low power switching of magnetic tunnel junctions.

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