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Spin-transfer torque in Co/Graphene/Co vertical heterostructures: A route toward magnetic memories with low write energy and ultrahigh magnetoresistance. KAPILDEB DOLUI, PO-HAO CHANG, University of Delaware, USA, FARZAD MAHFOUZI, California State University, USA, TROELS MARKUSSEN, KURT STOKBRO, QuantumWise A/S, Denmark, BRANISLAV K. NIKOLIĆ, University of Delaware, USA — The MgO-based magnetic tunnel junctions (MTJs) are presently the workhorse of first generation spintronics, based on magnetoresistitive phenomena, as well as for second generation spintronics largely focused on spin-transfer torque (STT) phenomena. Although MgO-based MTJs offer large tunneling magnetoresistance (TMR), required to detect current-driven magnetization switching from parallel to antiparallel state, they demand high bias voltage to initiate the switching dynamics which can lead to tunnel barrier degradation. Thus, an ideal physical system for envisioned STT-based memory devices and their integration with low-power CMOS technology would exhibit high TMR and low resistance-area (RA) product, ensuring small write voltages and write energy. Using first-principles quantum transport formalism, we predict that Co/Gr$_n$/Co vertical heterostructures, where Co(111) electrodes sandwich n layers of graphene, offer such physical system. Although Co/Gr$_1$/Co junctions show similar STT magnitude as Co/Cu/Co spin valves in the linear-response regime, TMR>100% requires Co/Gr$_3$/Co junctions whose RA product is still two orders of magnitude smaller than in MgO-based MTJs, while their magnetization switching can be initiated with bias voltages as small as $V_b < 0.1$ V.

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