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Voltage Control of Domain Wall Motion in Perpendicular Magnetic Anisotropy Materials[1] UWE BAUER, SATORU EMORI, GEOFFREY S. D. BEACH, Massachusetts Institute of Technology, Cambirdge, USA — High-performance solid-state operation of a wide variety of spintronic devices requires efficient electrical control of domain walls (DWs). In this work we examine DW dynamics in ultrathin Co films under the influence of an electric field applied across a gadolinium oxide gate dielectric. By measuring the velocity scaling with temperature, driving field, and gate voltage, we verify domain expansion via thermally-activated creep dynamics. We show that an electric field linearly modulates the activation energy barrier E_A that governs DW creep, leading to an exponential dependence of DW velocity on gate voltage. As a consequence, significant voltage-induced velocity enhancement can be achieved in the low-velocity regime, but the efficiency is diminished at high velocities where E_A is correspondingly small. We overcome this limitation by engineering novel device structures with significantly larger voltage induced effects on magnetic anisotropy and demonstrate voltage modulation of the DW propagation field by hundreds of Oe. Implementation into magnetic nanowire devices allows us to engineer gate voltage controlled DW traps which are nonvolatile and robustly switchable for many cycles.

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