The Magnetic Racetrack Memory: a shift register memory based on current induced precessional motion of domain walls.

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The current induced motion of magnetic domain walls confined to nanostructures is of interest for applications in magnetoelectronic devices in which the domain wall serves as the logic gate or memory element. A proposal for a novel storage-class memory is described in which magnetic domains are used to store information in a "magnetic race-track" [1]. The magnetic race-track promises a solid state memory with storage capacities and cost rivaling that of magnetic disk drives but with much improved performance and reliability: a "hard disk on a chip". The magnetic race track is comprised of tall columns of magnetic material arranged perpendicularly to the surface of a silicon wafer. The domains are shifted up and down the race-track by nanosecond long pulses of spin polarized current using the phenomenon of spin momentum transfer. We discuss the current induced resonant excitation and motion of domain walls in permalloy nanowires [2,3]. The injection of spin polarized current below a threshold value through a domain wall confined to a pinning potential results in its precessional motion within the potential well [4]. We show that, by using a short train of current pulses, whose length and spacing are tuned to this precession frequency, the domain wall's oscillations can be resonantly amplified [5]. This makes possible the motion of domain walls with much reduced spin polarized currents, more than five times smaller than in the absence of resonant amplification.

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