The Spin on Electronics!

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Recent advances in generating, manipulating and detecting spin-polarized electrons and current make possible entire new classes of spin based sensor, memory and logic devices, technology generally referred to as the field of *spintronics*. A magnetic recording read head, based on the *spin-valve,* is the first example of a useful spintronic device, and enabled a 1,000-fold increase in the storage capacity of disk drives in just a few years after its introduction[1]. Even greater sensitivity is obtained by replacing the spin-valve, which is based on diffusive spin-dependent transport, with the magnetic tunnel junction, which uses spin-dependent tunnelling. This latter spintronic device also enables a high performance, non-volatile magnetic random access solid state memory[1].

The respective strengths of disk drives and memory, i.e. the very low cost of disk drives and the high performance and reliability of solid state memories, may be combined in the Racetrack Memory. The Racetrack Memory is a novel three dimensional technology which stores information as magnetic domain walls in magnetic nanowires and manipulates them using spin polarized current pulses[2]. Spintronic materials and devices may even be important for developing devices that mimic the operation of the synaptic switches in the brain.

1. S.S.P. Parkin et al., *Magnetically engineered spintronic sensors and memory.* Proc. IEEE **91**, 661-680 (2003).
2. S.S.P. Parkin *et al*., Science **320**, 190 (2008); Scientific American (June, 2009).