Spin-Polarized Electronics: Past, Present, and Future

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Spin-polarized electronics, or "spintronics," is a relatively new paradigm for electronics in which the spin of the electron is used in addition to its charge. In this talk, I will discuss the past, present, and some thoughts on the future of this field. One interesting aspect of the research is the close ties between basic research and technology development. This is witnessed by the 1988 discovery of giant magnetoresistance, which was rapidly converted into commercial read heads for high density disk drives by IBM beginning in 1997. More recently, magnetic random access memory (MRAM) was unveiled last year by Freescale, based on discoveries of tunneling magnetoresistance in magnetic tunnel junctions in 1995. I will discuss the basic ideas about spin dependent transport for the operation of these devices, and discuss future directions for this technology based on recent advances in materials (MgO in particular) and spin-torque phenomenon. I will also discuss two intriguing concepts, namely spin coherence and pure spin currents, which might someday be useful for quantum information or low power electronics, respectively.

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