

# Spintronics Survey: Research and Application

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The manipulation of electron spin in metals and semiconductors offers new dimensions for basic and applied research, and the potential for new capabilities for electronics technology. In this survey, first a high level analysis gives a description of the market forces that shape new trends in the semiconductor and magnetic recording industries, and describes the emergence of spintronics as a technology that incorporates elements of both of these established fields. A more focused discussion describes niche applications of interest. Magnetic random access memory (MRAM) was commercialized successfully in the summer of 2006. Other applications, such as reprogrammable logic, are in a research and development stage. Finally, present and future generation spintronic devices are discussed from a perspective of their physical principles of operation and performance attributes. Magnetic tunnel junctions with MgO barriers have the greatest promise. Lateral spin valves may become viable at the size scale of tens of nanometers because they obey inverse scaling: the output modulation (DR) is inversely proportional to the sample dimensions. This scaling has been empirically confirmed over ten decades of device volume. There has been recent progress in the development of a spin injected field effect transistor (FET), but this device is still in early stages of research.