Advanced Nonvolatile Memories

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A B S T R A C T

Nonvolatile memories are still the unfinished program of the semiconductor device revolution since the invention of the transistor in 1947. It is also the area where most research has occurred since the late sixties when Khang and Sze introduced the tunneling oxide memory concepts that later led to EPROMs, EEPROMs, and finally FLASH. Currently, much is happening in this field as integrated circuits, specially System-on-Chip (SoC) are becoming dominant and are approaching over 90% of their area as de facto memory devices. Also, as the limits of both DRAMs and FLASH become clear barriers for new technology development, the search for nonvolatile memories has resumed with much vigor. In the embedded microcontroller and Near field Communication/energy harvest areas, the explosive growth of the now mature FeRAMs (Fe=Ferroelectric Materials such as PZT and SBT), is in full swing as the only low power and high endurance options. In the area of large scale "stand Alone" memories, there is activity and even initial products in two areas – STTRAMs (STT= Spin Torque Transfer) and ReRAMs (Re=Resistive). Within each category, there exists rich physics and materials science which deserve much attention as these technologies drive many aspects of knew knowledge or revision of incomplete understanding of the underlying physico-chemical operation of switching states and storage at the nano-scale. This paper will review the state-of-the-art of nonvolatile memories, their physics and technology, concentrating in some depth in resistance switching. It will also point out opportunities for research and development including activities that can lead to commercialization of these devices.

Plenary Talk
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2013