A Read-Disturbance-Free Nonvolatile Content Adressable Memory

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SUMMARY

UCLA researchers in the Department of Electrical Engineering have developed read-disturbance-free content addressable memory (CAM) using voltage controlled magneto-electric tunnel junctions (MEJs).

BACKGROUND

The electronics industry continuously demands for memory devices with higher density, faster speed, and better reliability. Memories configured as content addressable memories (CAMs) are particularly suitable in applications, including search-based systems, such as cache controllers, Ethernet routing, data compression, and pattern recognition. Currently, most CAMs are implemented using static RAM (SRAM)-based data storage. However, SRAMs are volatile and use large amounts of power. Spin-transfer torque (STT) magnetic tunnel junctions (MTJs) have recently been used to construct nonvolatile CAMs, which almost entirely eliminates static power dissipation by cutting the power supply during idle periods. Despite their advantages, the speed and reliability of MTJ-based CAMs are limited by their search noise margin. Thus, there is a need for a nonvolatile CAM with a high search noise margin, a high density, and low power dissipation in both static and active operation.

INNOVATION

Researchers at UCLA have constructed a nonvolatile CAM using magneto-electric tunnel junctions (MEJs) with a voltage-controlled switching mechanism. This allows writing information into the memory using different voltages of the same polarity, and reading information out of the memory with voltages of the opposite polarity. The voltage-controlled MEJ CAM eliminates the performance-reliability trade-off associated with bit readout during searching, and provides high performance read-disturbance-free operation.

APPLICATIONS

- CAMs for search-based systems (e.g. cache controller, ethernet routing, data compression, and pattern recognition)

ADVANTAGES

- Allows read-disturbance-free operation by eliminating the performance-reliability trade-off associated with bit readout
- Eliminates static power dissipation during idle periods

STATE OF DEVELOPMENT

The voltage-controlled MEJ CAM has been tested with computer simulations.

RELATED MATERIALS

- Zhu, J., Katine, J.A., Rowlands, G.E., Chen, Y.J., Duan, Z., Alzate, J.G., Upadhyaya, P., Langer, J., Amiri, P.K., Wang, K.L. and Krivorotov, I.N., 2012. Voltage-induced ferromagnetic resonance in magnetic tunnel junctions. Physical review letters, 108(19), p.197203.
- Wang, K.L., Lee, H. and Amiri, P.K., 2015. Magnetoelectric random access memory-based circuit design by using voltage-controlled magnetic anisotropy in magnetic tunnel junctions. IEEE Transactions on Nanotechnology, 14(6), pp.992-997.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9047950	06/02/2015	2012-876

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OTHER INFORMATION

KEYWORDS

Content addressable memory, CAM, magnetic tunnel junction, MTJ, magneto-electric tunnel junction, MEJ, solid state memory

CATEGORIZED AS

- **Computer**
  - Hardware
- **Semiconductors**
  - Other

RELATED CASES

2012-876-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Vertical-Stacked-Array-Transistor (VSAT) for Nonvolatile Memory Devices
- Magnetic Memory Bits with Perpendicular Magnetization Switched By Current-Induced Spin-Orbit Torques
- Vsat Structure for Nonvolatile Memory Device
- A Self-Organized Critical CMOS Circuit for Computation and Information Processing
- Anti-Ferromagnetic Magneto-Electric Spin-Orbit Read Logic

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