Anti-Ferromagnetic Magneto-Electric Spin-Orbit Read Logic

Tech ID: 29002 / UC Case 2017-456-0

SUMMARY

UCLA researchers in the department of Electrical Engineering have developed a novel magetoelectric device for use as a spin transistor.

BACKGROUND

The search for a novel and scalable logic technology could revolutionize the non-volatile memory market, which will be worth over $80 billion by 2022. Currently, non-volatile memory suffers from higher costs, lower performance, undesired heat generation, and/or lower write endurance compared to volatile memory. One proposed improvement is to develop spin transistors, where information is stored using the two spin states of electrons. This “holy grail” of materials science has been an intense research focus for over 20 years, but has yet to be significantly realized in scalable industrial applications.

INNOVATION

UCLA researchers have developed a novel device for use as a spin transistor. The logic state is stored as anti-ferromagnetic (AFM) order, which can be rapidly switched (30 ps) at room temperature by applying voltage. The device consists of narrow conductive channels adjacent to magnetoelectric films. When a voltage is applied, polarization and AFM order are switched in the magnetoelectric insulator. This AFM order then induces preferred conduction and lowered resistance in only one direction along the conduction channel. The logic state of the transistor can then be measured by measuring in which direction charge current flows.

APPLICATIONS

Spin transistor

ADVANTAGES

- Reliable room-temperature operation
- High gain enables cascading from one device to another
- Rapid write operation ~ 30ps
- Antiferromagnetic order is not sensitive to external magnetic fields

RELATED MATERIALS

- Peter A. Dowben, Christian Binek, and Dmitri E. Nikonov, “Potential of nonvolatile magnetoelectric devices for spintronic applications”, Chapter 11 in Nanoscale Silicon Devices; edited by Shuni Oda and David Ferry; Taylor and Francis (London) (2016) pp 255-278

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,361,292	07/23/2019	2017-456

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

CONTACT

UCLA Technology Development Group
ncd@tdg.ucla.edu
tel: 310.794.0558.



INVENTORS

- Wang, Kang L.

OTHER INFORMATION

KEYWORDS

spintronics, spin resistor, anti-ferromagnetic order, magneto-electric transistor, proximity induced spin polarization

CATEGORIZED AS

- **Computer**
  - Hardware
- **Engineering**
  - Engineering
- **Nanotechnology**
  - Electronics
  - Other
  - Tools and Devices
- **Semiconductors**
  - Design and Fabrication
  - Other

RELATED CASES

2017-456-0

- A Read-Disturbance-Free Nonvolatile Content Adressable Memory
- A Self-Organized Critical CMOS Circuit for Computation and Information Processing

UCLA Technology Development Group

10889 Wilshire Blvd., Suite 920,Los Angeles,CA 90095

https://tdg.ucla.edu

Tel: 310.794.0558 | Fax: 310.794.0638 | ncd@tdg.ucla.edu

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