SFU SIMON FRASER UNIVERSITY

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High Performance Spin Transfer Torque Magnetic Random Access Memory (STT-MRAM) Devices

Non-volatile memory that has the speed of the fastest commercial RAM but retains data for years

Request an introduction

Reference: 2017-002

Header image provided by the university

IP Status

Patent application submitted, Patented

Seeking

Development partner, Commercial partner, Seeking investment, University spin out

Background

The issue with existing RAM (DRAM and SRAM) technology is its volatility, which increases the energy consumption due to the need for a constant power source. The most promising non-volatile counterpart is STT-MRAM; however, existing STT-MRAM is probabilistic in nature as it relies on random thermal fluctuations for the “writing” process. For existing STT-MRAM technology to be competitive with DRAM or SRAM, a large current must be applied. This implies that the transistor supplying the current must be sufficiently large and is therefore the main limit to increasing the memory density. Additionally, the large current implies large losses making existing STT-MRAM less energy efficient than DRAM and SRAM for high-performance applications.

Tech Overview

Our novel coupling material allows for non-collinear geometry of magnetic materials, enabling the switching process to initiate immediately as soon as the current is applied, changing it from probabilistic to deterministic. This significantly lowers the amount and duration of current one needs to apply for “writing” and leads to an increase in writing speed at a lower energy cost. Micromagnetic simulations suggest up to a 2-fold reduction in writing current and up to a 3-fold reduction in writing speed as compared to existing STT-MRAM. The lower current requires a smaller transistor which allows for an increase in memory density. These improvements allow for the non-collinear STT-MRAM to compete with the performance of existing silicon-based RAM devices but with the additional advantage of lower energy consumption as a consequence of its non-volatile nature.

Benefits

- The non-volatility allows for long term data retention (~years) without any external power sources and therefore reduces energy consumption; this is the main advantage over silicon-based RAM
- Writing speeds comparable to the fastest commercial RAM devices
- Lower writing power than existing STT-MRAM devices
- Potential for higher memory density

Applications

Non-volatile forms of solid-state memory are favored in applications requiring power efficiency. These include military/aerospace, robotics (drones), automotive, internet of things (IoT), medical devices and wearable devices.

Patents

- US Pat. No. 10,204,671
- US Pat. No. 10,446,208
- US Pat. App. 16/562,337 (allowed on 25 January 2021)
- WO/2018/161146
- CA Pat. App. 2,998,012
- TW Pat. App. 201842517
- CN Pat. App. 110603618A

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