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Energy Efficient Spin Logic with Larger Output Voltage (20140235, Dr. Jian-Ping Wang)

Technology No. 20140235

Spin Logic Demonstrates Directionality of Spin Pumping

A spin based logic device uses spin pumping and spin transfer torque (STT) nano-oscillator for its operation. The device includes a spin channel to transport a spin current, a nano-oscillator and a magnetoresistive device that receives the spin current from the nano-oscillator. The nano-oscillator includes a magnetization state that oscillates between two states in response to an input voltage or current, and the oscillation of the nano-oscillator may induce the spin current within the spin channel. The magnetoresistive device includes a magnetization state that is set based at least in part on the received spin current. The logic is nonvolatile, directional and scalable, free from impedance mismatch and energy efficient, and offers larger output voltage, GHz operational speed and low power operation. This is the first instance of spin logic based on spin pumping and STT nano-oscillator, and directionality of the spin pumping is an important aspect for efficient operation of the devices.

CMOS Technology Compatible

This spin based logic device offers several advantages compared to other spin logic devices: The logic has higher spin injection efficiency and is:

- free from impedance mismatch of the magnetic and the spin channel (one of the major challenges in most of the spin based logic devices)
- nonvolatile, directional and scalable
- compatible with current standard CMOS technology

BENEFITS AND FEATURES:

- Spin pumping and STT nano-oscillator
- Nonvolatile
- Directional and scalable
- Free from impedance mismatch of the magnetic and the spin channel

- Compatible with CMOS technology
- Low power consumption
- Works with perpendicular magnetic material required for scalability and thermal stability of the logic
- Easily integrated with gate signal to reduce switching energy
- Easily synchronous using clock signal instead of gate voltage

APPLICATIONS:

- Spin based logic devices
- Logic devices
- Standard CMOS technology

Phase of Development – Proof of concept

Researchers

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