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Fast Magnetoelectric Device Based on Current-driven Domain Wall Propagation (20160364, Dr. Jian-Ping Wang)

IP Status: Issued US Patent; **Application #:** 15/600,958

Fast, Efficient, Low Power Spintronic Circuit

An electronic spintronic-based circuit device transmits a voltage from an input to an output in an energy efficient, fast and low-power manner. The device is comprised of an input ferroelectric (FE) capacitor and an output FE capacitor, each magnetically coupled to a ferromagnetic (FM) channel beneath the capacitors. When the input FE capacitor receives an input signal, it causes a magnetic signal (resulting from Spin-Transfer Torque (STT) in the FM channel) to pass through the FM channel to the output FE capacitor, causing a voltage change at the output FE capacitor. The electronic device may also include a transistor-based drive circuit electrically connected to the output node of the output FE capacitor to drive a second circuit device. Complex logic circuits can be formed by coupling input FE capacitors and output FE capacitors using these techniques.

Potential CMOS Replacement

Other spin logic solutions tend to be slow and power-hungry, and while current magnetoelectric and domain wall (DW) devices are energy efficient, they are also slow. This new device is both energy efficient and fast, and could potentially replace the CMOS transistor.

BENEFITS AND FEATURES:

- Fast magnetoelectric device based on current driven DW motion
- Low energy device
- Scalable geometries
- Micromagnetic simulation for DW nucleation

APPLICATIONS:

- Potential CMOS transistor replacement

Phase of Development - Proof of Concept

Researchers

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Category
Engineering & Physical Sciences/Nanotechnology
Engineering & Physical Sciences/Semiconductor

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Publications

CoMET: Composite- Input Magnetoelectric-based Logic Technology

IEEE Journal on Exploratory Solid-State Computational Devices and Circuits, Vol. 3, pp. 27 – 36, 06 April 2017

A Fast Magnetoelectric Device Based on Current-driven Domain Wall Propagation

Proceedings of the IEEE Device Research Conference, 19-22 June 2016

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