

## Energy Efficient Computing Devices

Magneto-elastic non-volatile multiferroic logic & memory

Currently, electron charge is used for encoding information and implementing memory and logic devices in electronic chips. Non-volatile memory, on the other hand, is implemented with magnetic devices such as spin-transfer-torque RAM (STT-RAM) that utilizes spin-polarized current to write bits into memory. These functions can be implemented in a much more energy-efficient manner by utilizing multiferroic nanomagnets whose magnetization states are switched with electrically-generated mechanical strain. Utilizing such methods could result in a drastic reduction of energy consumption thereby allowing stand-alone processors to be run with energy harvested from the environment. Subsequently, these methods could lead to advancements in fields such as biotechnology, computers, communication and defense.

### The technology

Researchers at VCU have designed a novel hardware concept that dissipates significantly less energy to compute or process information than conventional electronics by utilizing the inherent advantage of multiferroic nanomagnets. These nanomagnets, comprising strain-coupled magnetostrictive-piezoelectric planar nanostructures, switch and process digital information with extremely low energy loss and high reliability. They can be powered via energy harvested from their surrounding environment (no battery needed) making them ideal for applications such as: energy-efficient processors for mobile electronics, monitoring of brain waves through an implantable (battery-less) medical device to warn medical personnel of impending epileptic seizures and detection of submarines or targets using sensors powered by ocean waves, to name a few.

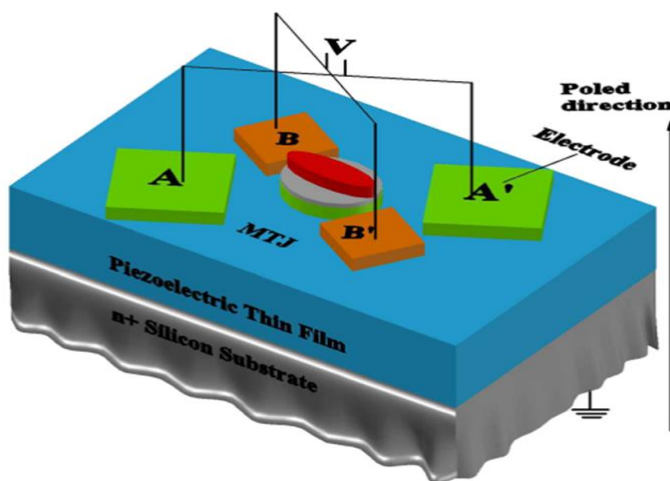


Figure 1. Schematic of the memory element as seen in Biswas, A. K., et al. (2014b)

### Benefits

- » Lower power consumption and energy loss
- » Logic gate is more advantageous compared to other devices
- » Non-volatile with lower energy delay
- » Can double as both logic and memory

### Applications

- » Mobile electronics
- » Implantable devices
- » Structural health monitoring
- » Submarine detection and target recognition

### Patent status:

Patent Filed: [US 2016/0141333 A1](#)

### License status:

This technology is available for licensing to industry for further development and commercialization.

### Category:

Computer memory

### VCU Tech #:

14-050

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### External resources:

[Biswas, A. K., et al. \(2014a\)](#)  
[Biswas, A. K., et al. \(2014b\)](#)  
[Biswas, A. K., et al. \(2013\)](#)

### Contact us about this technology

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