"AN ULTRA-LOW POWER PARADIGM USING MULTIFERROIC NANOMAGNETS" VCU #11-022

Applications

- Mobile electronics
- Structural health monitoring
- Biomedical applications such as implantable devices
- Defense applications such as submarine detection, target recognition
- Pattern recognition, image detection, face recognition

Advantages

- Powered via harvested environmental energy
- 100,000x the efficiency of spin-torque based non-volatile magnetic memory
- 1000-10,000x the efficiency of transistor based logic, memory systems

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Market Need

Currently, transistor-based computer architecture uses electron charge for information encoding, and spin-transfer-torque RAM (STT-RAM) utilizes spin-polarized current in logic applications. Similar computing and memory applications can be addressed with multiferroic nanomagnets, but in a more efficient manner. Utilizing energy-efficient technologies based on multiferroic nanomagnets would allow for reduced energy consumption during computing activities, and subsequently lead to advancements in fields such as biotechnology, civil engineering, and defense.

Technology Summary

VCU researchers have developed a new hardware concept that takes advantage of multiferroic nanomagnets. These nanomagnets, comprised of strain-coupled magnetostrictive-piezoelectric planar nanostructures, can be applied to memory, computing, and information processing. Specifically, this technology can be utilized in the creation of logic gates for CPUs, four-state logic devices, and non-volatile memory exhibiting energy efficiency 100,000 times and 1000-10,000 times that of current STT-RAM and transistor-based computer architecture, respectively. Furthermore, as these multiferroic nanomagnets require little energy to run, no battery or external energy source is necessary for operation. Instead, they can be powered via energy harvested from their surrounding environment. This makes the nanomagnets ideal for various applications. Examples include energy-efficient memory, storage, and CPUs for mobile electronics, identification of epileptic seizures through the monitoring of brain waves via an implantable medical device, monitoring systems that collect signals from mounted sensors to determine structural health, detection of submarines or targets during defense activities, and face or pattern recognition.

Technology Status

Patent Pending: US rights available.
This technology is available for licensing to industry for further development and commercialization.

Additional information about this technology has been published and a selection can be found at the following links:
Bennett clocking of nanomagnetic logic
Energy-efficient mixed mode switching
Magnetization Dynamics