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Single Nanomagnet Spintronics Memory Device

A simplified spintronics memory device utilizing a single free-layer nanomagnet structure enables unprecedented downsizing and circumvents the limitations of current magnetic tunnel junctions in memory technologies.

Semiconductor based memory technologies such as SRAM, DRAM, and Flash are nearing their fundamental limit. Magnetic random access memory (MRAM) is a viable replacement due to its virtually unlimited endurance and lower write time. Various MRAM architectures use a magnetic tunnel junction (MTJ) as the memory element and rely on high tunneling magnetoresistance (TMR) for reading operation. Process variation induces large variation of TMR and reliability issues create challenges in realizing high bit density MRAM arrays. Given these challenges in producing MRAM, there is a need for improvements in the field.

Researchers at Purdue University have developed a simplified spintronics memory device comprising a single free-layer nanomagnet structure. The magnetic orientation of the nanomagnet is controlled and sensed by charge currents flowing through a channel with spin momentum locking (SML) upon which the nanomagnet is fabricated. This technology offers new materials selection to optimize the writing and readout processes. This simplification allows for further downsizing of spintronic memories to unprecedented levels.

Advantages:

-Circumvents limitations of magnetic tunnel junctions

-Uses a single free-layer structure

-Optimizes the writing and readout processes

-Downsizing of spintronic memories to unprecedented levels

Potential Applications:

-Semiconductor based memory technologies

Technology ID

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Category

Semiconductors/Fabrication & Process Technologies
Semiconductors/Devices & Components
Materials Science & Nanotechnology/Nanomaterials & Nanostructures

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