INNOVATION PARTNERSHIPS
UNIVERSITY OF MICHIGAN

A Si-Based Crossbar Memory

Technology Number: 4183

OVERVIEW

High-density non-volatile memory using nanoscale amorphous-silicon switches

- Improves memory density and speed compared to traditional non-volatile memories
- Data storage, consumer electronics, and computing applications

BACKGROUND

The quest for high-density, non-volatile memory has driven innovations in the semiconductor industry. Historically, flash memory and other forms of non-volatile storage have been used to retain data without power. These technologies, while widely used, are limited by relatively slow programming speeds, endurance issues, and challenges in scaling down to smaller sizes. Consequently, there is a pressing need for improved memory technologies that provide higher density, faster programming speeds, enhanced endurance, and better data retention. This need is especially critical as the demand for more efficient and compact data storage solutions continues to grow in various technological fields, from consumer electronics to high-performance computing.

INNOVATION

The described technology introduces a high-density non-volatile memory system utilizing crossbar layouts of nanoscale amorphous-silicon (a-Si) switches. Each memory cell consists of an Ag top electrode, an a-Si layer, and a p-type Si bottom electrode, isolated using spin-on-glass or other dielectrics. These cells exhibit non-volatile resistive switching in response to voltage biases, with a cell area of ≤100 nm×100 nm, programming speeds of less than 50 ns, endurance exceeding 105 operations, an on/off ratio greater than 104, and years-long retention time. The on-state resistance can be adjusted by tweaking the voltage characteristics, enabling multi-bit storage. The system can achieve rectifying and non-rectifying behaviors based on design, and additional layers such as a P/N junction can improve performance. The cells with storage density of > 1010 cm-2 that can be randomly accessed and programmed, make this technology suitable for advanced data storage, consumer electronics, and high-performance computing applications.

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Category

Hardware

Engineering & Physical Sciences

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ADDITIONAL INFORMATION

US8071972 "A Si-Based Crossbar Memory"