Plasma Doping of Two-dimensional Materials for Making Nonvolatile Multi-bit Data Storage Memory Devices

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OVERVIEW

Plasma doping enables 2D material-based non-volatile multi-bit memory devices

- Reduces manufacturing costs by simplifying device architecture
- Applied in computers, smartphones, electronic labels, and medical tags

BACKGROUND

The pursuit of multi-bit memory devices, crucial for enhancing memory density in computing systems, has led to significant research in semiconductor advancements. Historically, multi-bit memories have been explored using materials such as organic semiconductors and inorganic nanowires. While organic-based memories offer flexible electronics potential, they suffer from a short lifespan, low mobility, and high resistance. Inorganic nanowires, though promising, face challenges with scalability. Phase-change materials provide high operation speeds but require precise nanostructuring. Additionally, conventional charge-controlled memories with floating gate structures necessitate costly processes like lithography and atomic layer deposition, making large-scale production economically impractical. Hence, there is a pressing need for a more cost-effective and scalable approach to developing reliable non-volatile multi-bit memory devices suitable for various applications.

INNOVATION

Researchers at the University of Michigan have developed a low-cost method for producing non-volatile multi-bit memory devices using plasma-doped two-dimensional (2D) materials like MoS2. By utilizing plasma-assisted doping processes, ambipolar charge traps with varying energy levels are created within the 2D semiconductors, enabling multi-bit data storage capabilities without complex floating gate structures. This innovation significantly simplifies the memory device architecture, reducing production costs and improving scalability. The method's effectiveness is demonstrated through stable multi-bit storage states achieved with well-differentiated conduction levels. Applications extend across various fields, including high-density memory for computing devices, flexible electronics like electronic labels and medical care tags, and next-generation computers leveraging multi-bit algorithms.

ADDITIONAL INFORMATION

INTELLECTUAL PROPERTY:

US9960175 "Field effect transistor memory device"