Voltage-controlled and Tunable Resistive Switch and Resistive Memory Device
Technology #17372

Applications

Memristors can be used in non-volatile solid-state memory in applications such as programmable logic, signal processing, neural networks, control systems, reconfigurable computing, and radio-frequency identification (RFID).

Problem Addressed

A conventional memristive switching device consists of two electrodes which are separated by a thin insulating layer. Usually, this device geometry is realized in a vertical stack of bottom electrode layer, insulating layer and top electrode layer. Application of a voltage or current across the insulating layer then typically results in the formation of a conductive filament through the insulating layer. However, conductive filament formation is a statistical process which is hard to control, difficult to predict, and usually occurs under conditions close to dielectric breakdown of the insulating layer. The proposed device is a three terminal device that does not rely on conductive filament formation for its memristive properties.

Technology

This device is a three terminal memory resistor or memristor. Two terminals are used to drive a current through an electrically conductive wire. The conductive wire is partially covered by an electronically insulating layer which simultaneously acts as a good ionic conductor. The insulating layer is then covered with a gate electrode layer which provides the third terminal of the device. With a voltage applied to the gate electrode, ionic species in the insulating layer can then be pumped to or away from the conductive wire, resulting in modifications of the interface and even of the bulk composition of the conductive wire. The conductive wire and insulator material are chosen such that these modifications in the interface and bulk chemistry result in significant modifications in the resistance of the wire. So in this device, it is not the resistance change in the oxide, but rather the resistance change in the conducting wire that gives rise to memristive switching.

Advantages

- Predictable memristive properties
- Flexible device structure

Categories For This Invention:

Electronics & Circuits
Electronic Components
Memory Components
Intellectual Property:
Voltage-controlled resistive devices
Issued US Patent

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