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## Moore's law back on track: highly improved data storage

### Keywords

Digital memory, Resistive Random Access Memory (ReRAM), Interface engineering, Beyond-Moore, Multi-layer, Strain, Memristor.

### Summary

The present invention relates to a new type of data storage of information at low power consumption, high storage density and retention. This is a new non-volatile memory type. The primary building block of Memristors (= Memory Resistor) is the metal oxide in which different resistance states can be addressed. The different resistance states can be used as “0” and “1” to store digital information.

### Background

The digitalization of the modern world requires an ongoing increase in computing power and data storage densities (Increase rate described by *Moore's law*). To date, computing and information storage is primarily based on Flash and DRAM memories operating on transistors (Fig. 1). These technologies are running into their physical limits with respect to further miniaturization and new technologies need to be established to overcome the limitations. One of the most promising memory technologies are Resistive switching memories operating on memristors. Their simple structure allows easy fabrication and high packing densities independent from the substrate.

### Invention

This invention gives new degrees of freedom to control the memristance of metal oxide based digital memories. Interfacial strain modulations of the oxide constituent of the memory: the commonly used single phase metal oxide building block (Fig. 2, left) is replaced by a multilayer composite (Fig. 2, right) that allows precise control of the interfacial strain state (Fig. 3). For this, different materials A, B, C, etc. with respective lattice constants can be stacked to achieve the desired properties. This allows "tuning" of the relevant properties of the memory.

### Patent Status

- Patent pending

### Features & Benefits

- New type of memory
- Lower energy consumption
- High data retention
- Option for 3D stacking
- Fast write/read times and high endurance

### Field of Application

- Replacement of DRAM and Flash memories in digital information storage
- Improvement of Memristor building blocks currently under development
- New type of a Strained Resistive Random Access Memory

### References & Institute

- Schweiger et al, "A Micro-Dot Multilayer Oxide Device: Let’s Tune the Strain-Ionic Transport Interaction", ACS Nano, 8, 5, 5032 (2014)
- ETH Zurich institute: Prof. J. Rupp, Electrochemical Materials, Höng-gerbergring 64, 8093 Zürich, Switzerland

Fig. 1: DRAM and Flash memories (USB-Stick)

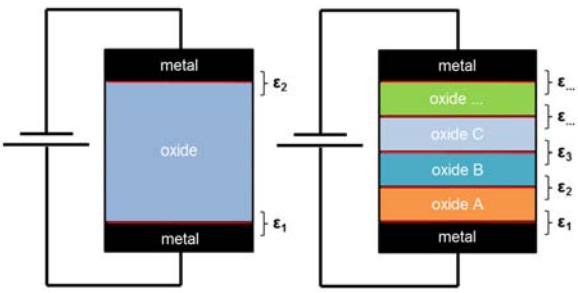


Fig. 2: State-of-the-art (left) and new concept (right), $\varepsilon_1$ to $\varepsilon_n$ indicate strain at the interfaces

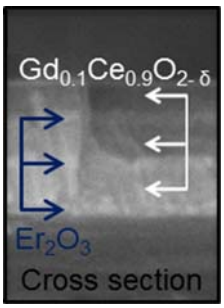


Fig. 3: cross-sectional view of a strained multilayer

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