Memristive devices based on molecular semiconductor materials

DESCRIPTION OF THE TECHNOLOGY

It is well-known that von Neumann architecture has a low efficiency in the processing of high amount of information caused precisely by this physical separation between the central processing and memory units. This non-desirable effect supposes a strong hindering in the development of future applications such as pattern recognition, artificial vision and big data mining. Currently, strong mitigation efforts are underway.

Memristive materials are ideal materials for neurohardware applications as they can combine information processing with memory storage in a single component, as neurons do.

In terms of real application, the characteristic that defines a memristive material is its ability to vary non-linearly its resistance according to previous history of voltage applied to it over a period of time. This property, called 'memristivity' has been proposed to be the foundation of vanguard computer science, from the design of new Resistive RAM (RRAM) that can surpass current Flash Disks and HDD advantages, to the opening of new in-memory computing paradigms. Despite the recent success of extended inorganic materials, no large-scale commercialization has yet been achieved, basically, because their memristive capabilities are inherently limited by low chemical variability and functionalization, by difficulties in nanostructuration, by poor reproducibility because of large parameter dependences and by limited cycling endurance.

Researchers from the University of Valencia have developed a memristive device prototype and its application in integrated circuits. In this aspect, the aim is to use this polymeric memristive material to efficiently implement synaptic elements in hardware-based neural networks.

The current presented materials are based on molecular chemistry and as demonstrated, show several advantages in front of those based on metal-oxides: 'a la carte' designs using molecular chemistry versatility, a strong reduction in size, flexibility, transparency and an optimum capabilities to be processed by soft low-cost techniques.

MARKET APPLICATION SECTORS

The invention applies to microelectronics sector market, mainly in computational systems based on integrated circuits that mimic neural networks with memristive hardware elements.

TECHNICAL ADVANTAGES AND BUSINESS BENEFITS

The main advantages provided by the devices of the invention are:

- Versatility of molecular chemistry to create custom designs
- Notable reduction in terms of size and energy requirements
- Optimal processing capacity through low-cost mild techniques
- Complete reversibility in the reading and writing process

CURRENT STATE OF DEVELOPMENT

The compounds have been validated at laboratory level.

INTELLECTUAL PROPERTY RIGHTS

The technology is protected through Spanish patent application P202130383, entitled "Dispositivos

memristivos basados en materiales polímeros semiconductores mediante el fenómeno de migración iónica " and priority date 30/04/2021, and by its patent family.

COLABORATION SOUGHT

- User license agreement.
- Subcontracting agreement with companies and/or institutions.

RELATED IMAGES

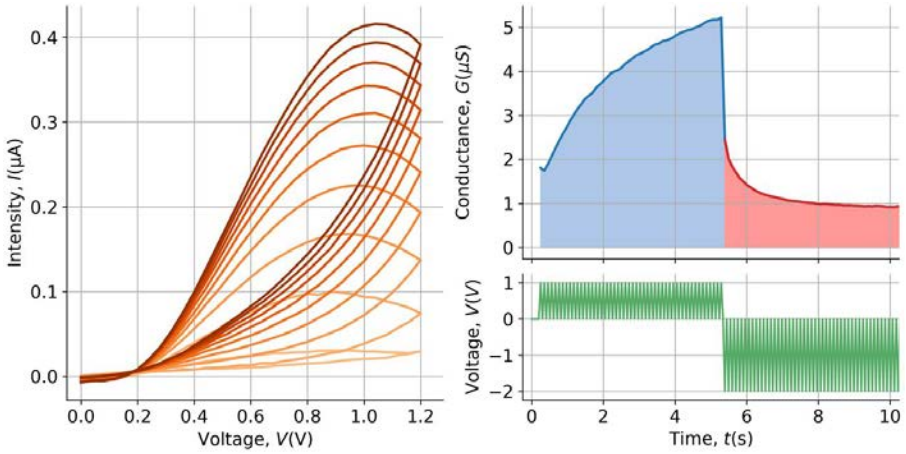

Figure 1: Left, graph of current intensity versus voltage showing hysteretical behavior. Right, top Conductance obtained after applying successive voltage pulses modifying the resistance of the device proportionally and bottom, diagram of the applied voltage sequence to obtain the previous current profile.

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