

“Memristor & Content Addressable Memory”

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Abstract: -Memristor is the fourth fundamental passive element after resistor, inductor and capacitor. Memristor is memory resistor which is two terminal device. This semiconductor device is statistically proved by a student in china Leon Chua in 1971. And discovered by scientist. R.Stanley Williams and its team in April 30,2008 in lab of HP. It consist a semiconductor of titanium dioxide in which one half is highly doped and other part is undoped. The need of memristor is high switching speed and non-instability, low power consumption. In this device we remember the last input and in simple resistor we don't remember. This paper presents the hypothetical analysis of model of memristor and it's application which is content addressable memory which is very advance equipment in today's world .

Keywords-non-instability, memristor ,resistor

1 INTRODUCTION

Memristor is basically a electronic device which is the fourth device rather than resistor, capacitor and inductor. It has the capability to store and remember a previous input applied to the device. It is concatenation of memory resistor which is the to terminal device. This device is first introduced by Leon Chua in china in 1971 and discovered by scientist R.Stanley Williams and it's team in Hewlett Packard lab in 30 April 2008. This semiconductor is made up of titanium dioxide based nano structure in which one half is doped with oxygen impurities and other half is behave like insulator [1]. The main reason is to develop

this technology is advancement the computing technologies and improves the computing performance the memristor is best Nano device to do this. There are different types of memristor which are spintronic memristor, polymeric memristor, magnetic memristive system, spin memristive etc. are being used for different purpose but the main aim of memristor is to provide the high performance, low power consumption and high speed. In today's modern world many of the electronic devices are not able to perform as per the requirement[2]_[3]. Due to everyday innovation in new technologies standard resistor are somewhere getting defeated. To avoid these complicated condition it is very necessary to improve the standard and level of electronic devices.

When multiple memristors are connected together, the behaviour of the composite device is difficult to predict due to the polarity dependent nonlinear variation of memristance of individual memristor[4].

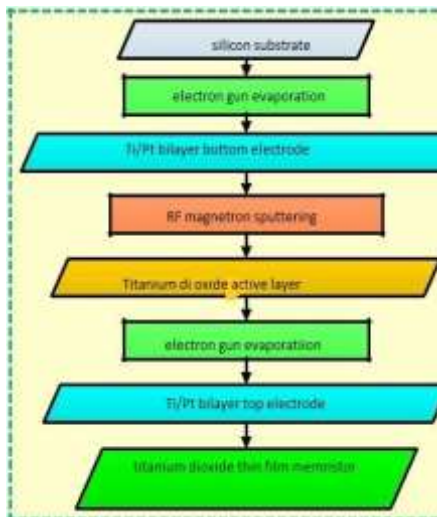


Fig no 1 fabrication of memristor[4]

2 PRINCIPLE

The basic theory of memristor is defined as two terminal device in which a magnetic flux (Φ_m) between the terminal is a function of total of electric charge (q) that has passed through it.

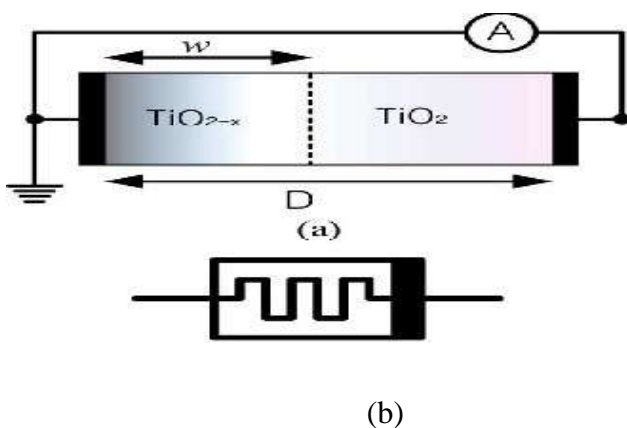


Figure no. 2 (a) Construction of the TiO memristor TiO and TiO layers are inserted between two platinum electrodes. When a voltage/current is applied ,its memristance/memductance is altered. (b) Symbol of the memristor[7].

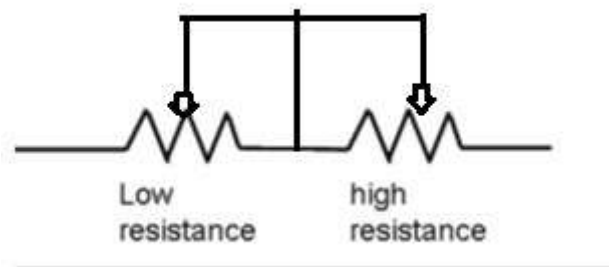


Figure no.3 memristor biasing [4].

When the semiconductor which is made up of titanium dioxide is fully doped in which 'w' is width and 'D' is the distance is $w=D$ then it has low resistance and high resistance in this it is fully undoped $w=0$. it is defined as the sum of doped area and undoped area indicated total resistance.

In this when voltage is passes in given direction the boundary between two area is moving in same direction and if we cut off the applied voltage the current stop flowing and boundary stop moving and element remembers it's resistance for long time.

As we all know that, resistor 'R' is defined as linear relation b/w voltage and current ($dv=Rdi$), As capacitor 'C' is defined as linear relation b/w voltage and electric charge ($dq=Cdv$), As inductor 'L' defined as linear relation b/w magnetic flux and current ($d\Phi=Ldi$) and sixth fundamental relation is developed b/w magnetic flux and electric charge which is called memristor

$(d\Phi=Mdq)$.

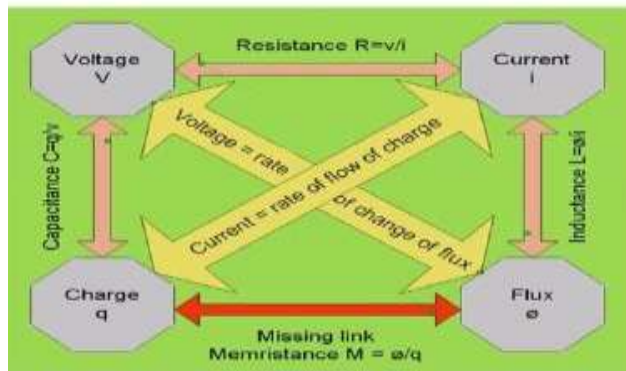


Figure no.4 –memristor relation with other element[8].

3 PROPERTIES OF MEMRISTOR

It is a property of an electronic component to maintain its resistance level change of flux with charge even after power had been shut down. Each memristor is characterized by its memristance function describing the charge-dependent rate of change of flux Memristor remember the resistance when power is OFF & then ON [5]. They can also do logic gates and as well as store bits at same time. In this when current moves in one direction the resistance increases and in opposite direction resistance decreases or it will not go below zero. They are very tiny in size. Where ‘M’ is dimension of resistor [6].

4 APPLICATION OF MEMRISTOR

They are many application of memristor in which it consist of Content addressable memory, It also

used in image processing, It also used in analog circuit(resistance changes acc. to voltages), It also used in Neuro morphic system ,It also used as Logic circuits / computation, It Applied for non-volatile RAM.[5]

CONTENT ADDRESSABLE MEMORY(CAM) is also known as associative memory, that is an the functional development of random access memory, in which current hardware based CAM is mainly realized which is based on static random access memory .CAM support not only write and read operations, but also explore operations. CAM also have be commonly used in computational systems, in certain organizational solutions where the CAM could efficiently perform the fast operations of processing, checking and book –keep in needed in the moving and rearrangement of data . Basically, CAM also work in such a way that it compares the bits, that are searched against the stored in CAM stored devices and return to the address of matching the data, which is totally different with traditional RAM[1].

5. CONCLUSION

Memristors which are being scaled up to 3nm has potential beyond the Nano scale CMOS which are face periods of challenge away from 18nm. The memristor models are needed by the design engineers which are not still mature to be used for accurate SPICE simulations. They don’t having any libraries available for physical design of a the or memristor-based circuits. MATLAB, Verliog

-A, and primitive SPICE models are existing for simulation of memristor circuits and systems. Research are in the full swing for improvement of models. The Use of memristor for analog circuits such as voltage controlled and oscillators are travelled to the circuit level. Digital design of memristor will need lots of research effort as Boolean logic can't be straight implement. It is stated that the solid-state memristors combined with crossbar latch can be potentially replace transistors in Nano electronic circuits and build then in smaller area. It can be used to make high-density non-volatile solid state resistive memory. The memristor along with the memcapacitor and the meminductor can potentially provide low power circuits and sensors [4].

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