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RRAM Technology: A Promising Non-Volatile Memory Solution

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Abstract- Resistive Random Access Memory (RRAM) is a promising non-volatile memory technology that has been attracting significant attention from researchers in recent years. This review article summarizes its working principle, materials, device fabrication techniques, and its applications. RRAM has the potential to provide high-density, low-power, and high-speed data storage, making it a promising candidate for replacing existing memory technologies such as Flash memory. The development of RRAM devices requires a deep understanding of the materials, device fabrication techniques, and the underlying resistive switching behavior. Although significant progress has been made in the development of RRAM devices, there are still many challenges that need to be addressed, such as device scalability, reliability, and endurance.

Keywords—RRAM, LRS, HRS,SET,RESET.

I. INTRODUCTION

Resistive Random Access Memory (RRAM) is a promising non-volatile memory technology that has been attracting significant attention from researchers in recent years. RRAM has the potential to provide high-density, low-power, and high-speed data storage that can replace existing memory technologies such as Flash memory. This review article summarizes the current state-of-the-art in RRAM research, including its working principle, materials, device fabrication techniques, and its applications [1-3].

RRAM has several benefits over other nonvolatile memories, i.e., simple fabrication, wonderful scalability, structural simplicity, high density of integration, rapid switchover, and better compatibility with CMOS technology [4-24]. Tables 1 demonstrate how RRAM compares to the other memory devices on the market.

II. WORKING PRINCIPLE

RRAM is a type of memory that uses a resistive switching mechanism to store data. The device consists of a metal-insulator-metal (MIM) or metal-insulator-semiconductor (MIS) structure, where the insulator layer is typically a thin film of metal oxide. The resistance of the insulator layer can be changed by applying a voltage to the device, which causes the formation or rupture of conducting filaments within the insulator layer. This change in resistance can be used to represent binary data, with high and low resistance values corresponding to the "1" and "0" states, respectively [25]. The basic structure of a RRAM cell is shown in figure 1 below.

Table 1 Comparison of emerging nonvolatile memories.

Memory Technology	Density	Endurance	Read/ Write Speed	Power Consumption	Data Retention	Cost
Phase Change Memory (PCM)	High	High	Moderate	Moderate	Long	High
Magnetoresistive Random Access Memory (MRAM)	Moderate	High	Fast	Low	Long	High
Ferroelectric Random Access Memory (FeRAM)	Moderate	High	Fast	Low	Long	High
Resistive Random Access Memory (RRAM)	High	High	Fast	Low	Long	Moderate

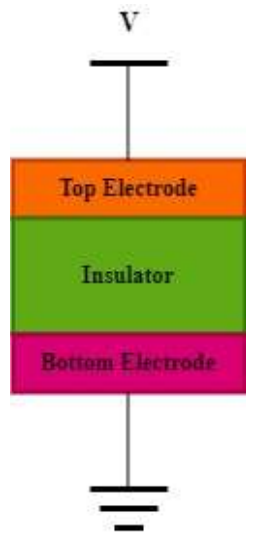

Figure 1: Basic Structure of RRAM memory cell