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W 도핑된 ZnO 박막을 이용한 저항 변화 메모리 특성 연구

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Next-generation nonvolatile memory (NVM) has attracted increasing attention about emerging NVMs such as ferroelectric random access memory, phase-change random access memory, magnetic random access memory and resistance random access memory (RRAM). Previous studies have demonstrated that RRAM is promising because of its excellent properties, including simple structure, high speed and high density integration. Many research groups have reported a lot of metal oxides as resistive materials like TiO2, NiO, SrTiO3 and ZnO [1]. Among them, the ZnO-based film is one of the most promising materials for RRAM because of its good switching characteristics, reliability and high transparency [2]. However, in many studies about ZnO-based RRAMs, there was a problem to get lower current level for reducing the operating power dissipation and improving the device reliability such an endurance and an retention time of memory devices. Thus in this paper, we investigated that highly reproducible bipolar resistive switching characteristics of W doped ZnO RRAM device and it showed low resistive switching current level and large ON/OFF ratio. This may be caused by the interdiffusion of the W atoms in the ZnO film, whch serves as dopants, and leakage current would rise resulting in the lowering of current level [3]. In this work, a ZnO film and W doped ZnO film were fabricated on a Si substrate using RF magnetron sputtering from ZnO and W targets at room temperature with Ar gas ambient, and compared their current levels. Compared with the conventional ZnO-based RRAM, the W doped ZnO ReRAM device shows the reduction of reset current from $\sim 10^{-6}$ A to $\sim 10^{-9}$ A and large ON/OFF ratio of $\sim 10^{3}$ along with self-rectifying characteristic as shown in Fig. 1. In addition, we observed good endurance of 10^{3} times and retention time of 10^{4} s in the W doped ZnO ReRAM device. With this advantageous characteristics, W doped ZnO thin film device is a promising candidates for CMOS compatible and high-density RRAM devices.

References

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