

Effect of Co doping on the resistance switching behavior of Zn_{1-x}O:Co_x Films

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Resistive random access memory (RRAM) is considered promising for next-generation nonvolatile memory application. Resistive switching (RS) phenomena have been studied in many materials including organic materials, binary transition metal oxide, and perovskites^[1]. Among these materials, zinc oxide (ZnO) has been widely investigated owing to its simple composition, reversible and steady RS performance^[2]. In our work, the Zn_{1-x}O:Co_x films have been prepared on Pt/TiO₂/SiO₂/Si substrates by the sol-gel method. The influence of Cobalt doping concentration on the forming behavior was studied. The coexistence of Forming Free (FF) and Forming Necessary (FN) unipolar RS behaviors had been found in pure ZnO, 1% doped and 3% doped ZnO films. But for 5% Co doped ZnO film, all the devices need the forming process. It means that the percentage of FF devices decreased with the increase of Co doping concentration. Additionally, there is an obviously difference between FF devices and FN devices in the distribution of the set voltage, i.e., with same film composition, the set voltage of FF devices was more stable as compared to that of the FN devices (Figure 1). This may be due to the pre-existing filamentary paths in pristine devices that showed FF switching, and the conductive filaments can easily re-connect along similar paths after rupture^[3]. These results suggest that FF devices with relative stable set voltage can be prepared by adjusting the synthesis parameters of Zn_{1-x}O:Co_x films, which should promote the realization of practical RRAM devices.

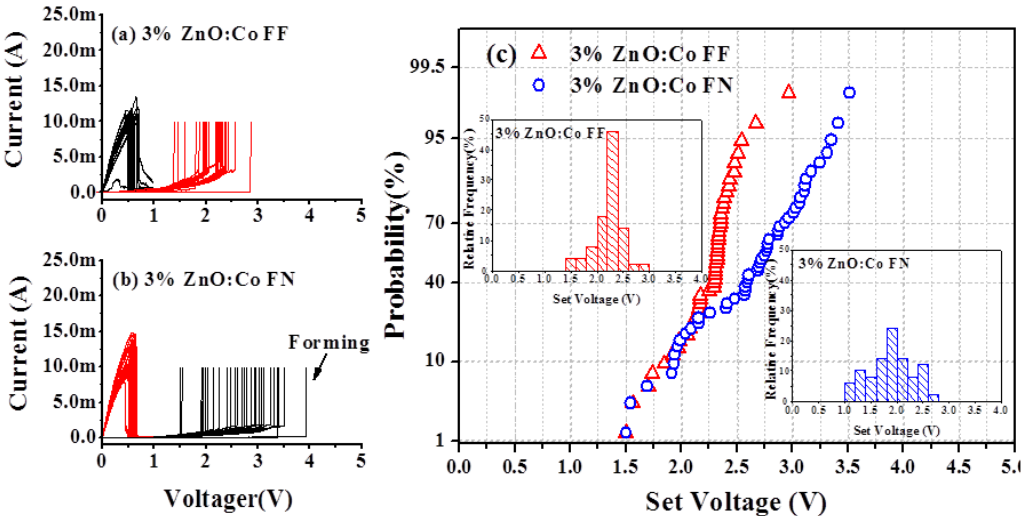


Fig. 1 (a) (b) the typical I-V curves of 3% Co doped ZnO film in FF and FN devices; (c) the accumulative probability of Set Voltage in FF and FN devices, inset was the distribution of the Set voltage.

References

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