

31ST MATERIALS SCIENCE AND ENGINEERING CONFERENCE: ADVANCEMENT & INNOVATIONS

October 15-17, 2018 Helsinki, Finland

Optimize the performance of graphene-based resistive random access memory device with the effective decoration of MoS₂

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Graphene and its derivatives are widely used in Resistive Random Access Memory (RRAM) for their outstanding electrical properties. Considering the simplicity and economy of preparation method, Graphene Oxide (GO) and reduced Graphene Oxide (rGO) have attracted much more attention than graphene obtained by Chemical Vapor Deposition (CVD). However, suffering from the poor conductivity caused by a large number of defects, GO and rGO exhibit poor performance in RRAM. To overcome this issue, a material with good conductivity can be used to improve the conductivity of GO or rGO. As a member of graphene-like materials, molybdenum disulfide (MoS₂) is an appropriate additive due to its good electrical conductivity and easily obtained in solution. In this paper, MoS₂ was synthesized and introduced into GO in different ways to fabricate the memory devices. After the effective mixture of MoS₂ and GO, the device exhibited a memristor performance, with the on/off ratio of 20, which dramatically changed the poor performance of pure GO in memristor. In order to further improve the poor conductivity of GO and solve the problems caused by defects, GO powder, thiourea and sodium molybdate were simultaneously used to participate in the reduction reaction to form rGO-MoS₂. MoS₂ microspheres adhere tightly to the rGO sheets participating in the charge trapping and releasing process between rGO sheets while increasing the conductivity of the system. An outstanding memory performance was obtained from rGO-MoS₂-based memory device showing an extremely high on/off ratio of 1000 which is 50 times higher than before. The results indicate that rGO-MoS₂ has great application potential in the resistive memory which plays an important role in the subsequent research on RRAM.

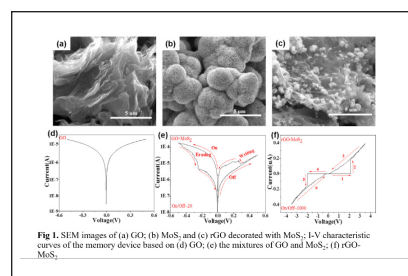


Fig 1. SEM images of (a) GO; (b) MoS₂; and (c) rGO decorated with MoS₂; I-V characteristic curves of the memory device based on (d) GO; (e) the mixtures of GO and MoS₂; (f) rGO-MoS₂.

Biography

Minghui Cao is a PhD candidate in School of Electronic and Information Engineering from Xi'an Jiaotong University. She is pursuing her Doctor's degree in Electronic Science and Technology. Her research interests include the preparation of flexible nano-materials and their applications in wearable devices.

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