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Interface-Controlled resistive switching behavior of molybdenum oxide semiconductor

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Floating gate memory has been widely used in non-volatile data storage, because it has fast data write/read capability, high-capacity storage, low-power consumption, and high endurance. However, recently, resistive random access memory (RRAM) has been proposed to be a new candidate for nonvolatile memory device technology, because it not only has the advantages that are mentioned above but also has a lower production cost than that of a floating gate memory due to its simple metal semiconductor metal (MSM) structure. This study demonstrated a high-performance interface-controlled MoO_x RRAM fabricated by using a radio-frequency (RF) sputter. A glass substrate was firstly cleaned by ultrasonic agitation in acetone, ethanol and de-ionized water, respectively. Then, Pt was deposited as a bottom electrode and a molybdenum oxide thin film was subsequently deposited by RF sputtering a MoO_3 target at oxygen flow rates of 0, 6, 9, 12,15 sccm. The argon flow rate was 12 sccm, the RF power was 40 W, and the working pressures was 3×10^{-3} torr. Finally, Al top electrodes were deposited on the MoO_x layer by evaporation and patterned by a shadow mask. The MoO_3 RRAM exhibits a significant memory window of 10^2 for 500 operations. The resistive switching mechanism was found to be dominated by formation/dissociation of an interfacial AlO_x layer between Al electrode and MoO_x active layer. The carrier transport mechanism was also investigated. The morphologies and thicknesses of the MoO_x films were measure by using a scanning electron microscope (SEM). An X-ray diffraction (XRD) was employed to examine the crystallinity of the MoO_x films. A UV-visible spectroscopy was used to study the transparency and the optical band gap. chemical structures of MoO_x films were clarified by using X-ray photoelectron spectroscopy (XPS). This approach can be applied to future high-performance RRAM technology.

Biography

Chih-Chieh Hsu has his expertise in semiconductor process and semiconductor device physics. He has much experience in thin film transistors, resistive memories, and sol-gel processes. He has published 15 SCI journal papers in the past three years. This approach will be applicable to future high-performance semiconductor devices.

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