Study of the mechanism for electrically erasable writing of ZnS films by conductive atomic force microscopy

Lingyan Xu[1,2]*, Aoqiu Wang[1,2], Hui Yu[1,2], Wanqi Jie[1,2].
*lead presenter: xulingyan@nwpu.edu.cn
1 State Key Laboratory of Solidification Processing, School of Materials Science and Engineering, Northwestern Polytechnical University, Xi'an 710072, China
2 Key Laboratory of Radiation Detection Materials and Devices, Ministry of Industry and Information Technology, School of Materials Science and Engineering, Northwestern Polytechnical University, Xi'an 710072, China

Resistive switching cycles were realized in Au/ZnS/substrate (indium–tin oxide (ITO), Cu, and Si) structures, and electrically erasable writing operations were achieved in the Au/ZnS/Si structures using conductive atomic force microcopy. High-resolution transmission electron microscopy revealed that the high-resistance state (HRS) was a mixture of amorphous and nanocrystalline states, while the frequency response of alternating-current conductivity indicated that the low-resistance state (LRS) was only nanocrystalline. Electric field and thermal effects contributed to the distribution of conductive defects in the ZnS film, and nearest-neighbor hopping conduction controlled the electrical resistance of the Au/ZnS/ITO structure. X-ray photoemission spectroscopic analysis of conductive defects of ZnS films in the LRS revealed that they were zinc-rich or sulfur-poor. This study confirms the intrinsic resistive switching characteristic of ZnS films, which can serve as nonoxide materials for nonvolatile memory application.