Electric-Field Induced Structural Transition in High-Performance High Entropy Oxide-Based Memristor

Jing-Yuan Tsai[1], and Wen-Wei Wu[1]
Department of Materials Sciene and Engineering, National Yang Ming Chiao Tung University, Hsinchu, Taiwan
WWWu@mail.nctu.edu.tw

Abstract

The application of high-entropy oxides (HEO) has attracted significant attention in recent years owing to their unique structural characteristics, such as excellent electrochemical properties and long-term cycling stability. However, the application of resistive random-access memory (RRAM) has not been extensively studied, and the switching mechanism of HEO-based RRAM has yet to be thoroughly investigated. In this study, we grew high-entropy oxide (Cr, Mn, Fe, Co, Ni)3O4 with a spinel structure on a Nb: STO conductive substrate epitaxially and deposited Pt metal as the top electrode. After the resistive switching operation, some regions of the spinel structure were transformed into a rock-salt structure and analyzed using advanced transmission electron microscopy (TEM) and scanning transmission electron microscopy (STEM). From the results of X-ray photoelectron spectroscopy (XPS) and electron energy loss spectroscopy (EELS), only specific elements would change their valence state, which results in excellent resistive-switching properties with a high on/off ratio on the order of 105, outstanding endurance (>4550 cycles), long retention time (>104 s), and high stability, which suggests that HEO is a promising RRAM material.

Keywords - atomic-scale evolution, high-entropy oxide, resistive random-access memory, resistive switching structural transformation