Effect of pulsed magnetic field annealing on the resistance switching property of Fe doped ZnO thin films

Chunli Liu[a,*], Changjin Wu[a], Hongtao Xu[a,b], Deok Hyeon Kim[a]

[a]Department of Physics and Oxide Research Center, Hankuk University of Foreign Studies, Yongin 449-471, Korea
[b]Laboratory for Microstructures/School of Materials Science and Engineering, Shanghai University, 149 Yanchang Road, Shanghai 200072, P.R. China
[c]Department of Electrophysics, Kwangwoon University, Seoul, 139-701, Korea

The 5% Fe doped ZnO (ZnO:Fe) thin films were deposited on $Pt/TiO_2/SiO_2/Si$ substrates by a spin coating method. The films were annealed without (ZnO:Fe-0T) and with (ZnO:Fe-4T) a pulsed magnetic field of 4 T to investigate the magnetic annealing effect on the resistance switching (RS) behavior of Pt/ZnO:Fe/Pt structures. As compared to the ZnO:Fe-0T film, the ZnO:Fe-4T film showed improved RS performance regarding the stability of the set voltage and the resistance of the high resistance state (HRS). TEM image showed that the crystalline grains of the ZnO:Fe-4T film was more uniform and XPS spectrum of the O1s peak suggested that there were more oxygen vacancies in ZnO:Fe-4T film, which promoted forming free switching with a quite narrow distribution in the set voltage and HRS resistance. These results suggest that application of external magnetic fields during the process of ZnO:Fe film synthesis can improve the RS characteristics of ZnO thin films for stable and low power consuming memory devices.