Wake up and Retention in Zinc Magnesium Oxide Ferroelectric Films

L. Jacques, G. Ryu, D. Goodling, S. Bachu, R. Taheri, P. Yousefian, S. Shetty, B. Akkopru-Akgun, C.A. Randall, N. Alem, J.P. Maria, S. Trolier-McKinstry

$Zn_{0.64}Mg_{0.36}$ O (ZMO) is a newly discovered ferroelectric oxide with the wurtzite structure. Epitaxial $Zn_{0.64}Mg_{0.36}O$ films from 0.036 to 0.5 mu m in thickness are grown on Pt/sapphire with the crystallographic c-axis out of plane. At room temperature, the remanent polarization is similar to 80 mu C/cm(2) and the coercive field is similar to 3 MV/cm. The coercive field is strongly temperature dependent up to 240 degrees C with a pseudo-activation energy of 23 +/- 0.3 meV, suggesting that polarization reversal occurs through an extrinsic process such as domain wall motion. ZMO films can be woken up in 20 electric field cycles on driving near the coercive field; they wake up in a single loop at fields in excess of 4MV/cm. A thermally activated fluid imprint process, with a pseudo-activation energy of 67 +/- 8meV, enlarges the coercive field by several hundred kV cm(-1) after switching the polarization. Additionally, ZMO films exhibit excellent retention characteristics; no reduction in the polarization is observed up to 1000 h from room temperature to 200 degrees C bakes. This current early generation of ZMO films can survive several thousand switching cycles before dielectric breakdown occurs.