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Probing of polarization reversal and charge conduction in epitaxial $(Ga,Fe)_2O_3$ thin films on conducting oxide $SrRuO_3$

R.H. SHIN, S.H. OH, J.H. LEE, W. JO[1], Department of Physics, Ewha Womans University, Korea, C. LEFEVRE, A. TOMASSON, F. ROULLAND, C. MENY, N. VIART, Institut de Physique et Chimie des Materiaux de Strasbourg, France — $Ga_{2-x}Fe_xO_3$ (GFO) thin films are the promising room-temperature multiferroics since their magnetic T_C has been reported up to 370 K at x=1.4. However, most polarization hysteresis loops of the GFO thin films have been showed lossy behaviors due to the large leakage current. The origin probably lies on charge movement between Fe^{3+} and Fe^{2+} sites which is generated by oxygen vacancy. We report the large reduced leakage current of the GFO thin films by chemical doping to reduce Fe^{2+}. The doped GFO thin films were deposited by pulsed laser deposition at 750°C for 15 min in oxygen partial pressure of 200 mTorr on $SrRuO_3/SrTiO_3$ substrates with various doping concentration. Epitaxy of b-axis orientation in out-of plane was confirmed by x-ray diffraction. The leakage current was reduced up to 5∼6 order of magnitude depending on doping concentration. In order to investigate their conduction mechanism, temperature dependent macroscopic I-V curves were measured. Ferroelectric polarization and switching of the films were acquired over a wide range of temperature as well. Scanning probe microscopy has been used to measure local leakage currents as well as polarization reversal as a mode of conductive atomic force microscopy and piezoelectric microscopy, respectively. Local investigation of their electrical properties alludes to ferroelectricity in GFO.

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