Ferroelectric and Magnetic Properties of $Al_xFe_{2-x}O_3$ Thin Films

Badari Narayana Aroor Rao[1,*], Tsukasa Katayama[2], Shintaro Yasui[1], Tomoyasu Taniyama[1,3], Mitsuru Itoh[1]

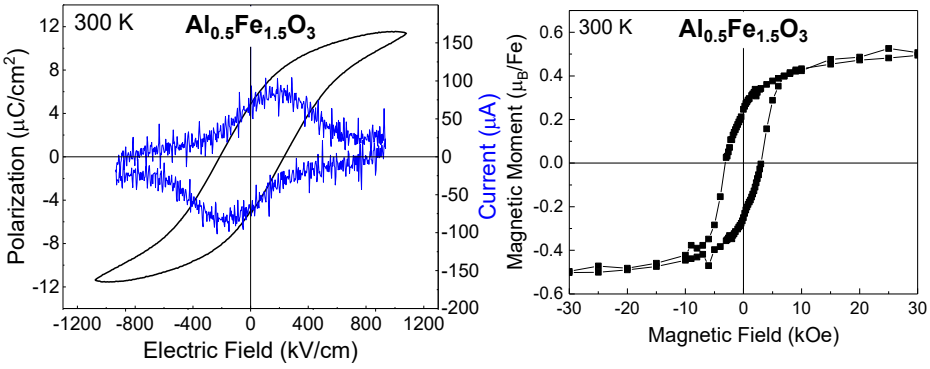
[1] Lab. for Materials and Structures, Tokyo Institute of Technology

[2] Dept. of Chemistry, The University of Tokyo

[3] Grad. School of Science, Nagoya University

E-mail: rao.b.aa@m.titech.ac.jp

Single-phase multiferroic materials have attracted considerable attention among scientists, as they enable development of many novel electronic devices. Currently, most of the discovered materials are multiferroic only at low temperatures, thereby hindering their induction into practical devices. κ-Al_2O_3 type $Al_xFe_{2-x}O_3$ (*x*-AFO) oxides belong to a relatively new class of metastable multiferroic compounds (space group: $Pna2_1$), which can be stabilized as thin films. We have found that some compositions of *x*-AFO can exhibit both ferrimagnetism and ferroelectricity at room temperature. The *x*-AFO system is attractive compared to other systems such as $GaFeO_3$ since both Al and Fe are environment friendly, and abundantly available in the earth's crust. Though epitaxial films of *x*-AFO have been grown earlier, only indirect evidences of room temperature ferroelectricity in *x*-AFO are available in literature till date. Presence of large leakage currents in *x*-AFO makes it difficult to carry out ferroelectric and magnetoelectric measurements at room temperature. We have used pulsed laser deposition technique to successfully fabricate epitaxial thin films of *x*-AFO on $SrTiO_3$ (111) substrates. The room temperature leakage current was significantly reduced for the films by careful tuning of deposition parameters. Direct ferroelectric measurements could be carried out on the films at room temperature, showing good hysteresis loops for *x*-AFO (x = 0.5 – 1.0). While the ferroelectric characterization showed that the coercive electric field increases with increasing *x*, magnetic measurements showed that the coercive magnetic field decreases with increasing *x*. Dielectric and magnetocapacitance studies were also carried out for the system and the results are briefly discussed.



Room temperature ferroelectric and magnetic measurement of $Al_{0.5}Fe_{1.5}O_3$