

(Supplemental)

Atomic layer deposition of antiferroelectric La-doped $\text{Hf}_{0.5}\text{Zr}_{0.5}\text{O}_2$ thin film and its electrical behaviors

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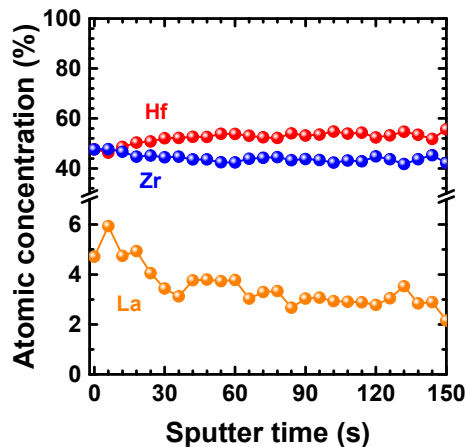


Figure 1. XPS depth profile result of La-doped $\text{Hf}_{0.5}\text{Zr}_{0.5}\text{O}_2$ (LHZO) thin film.

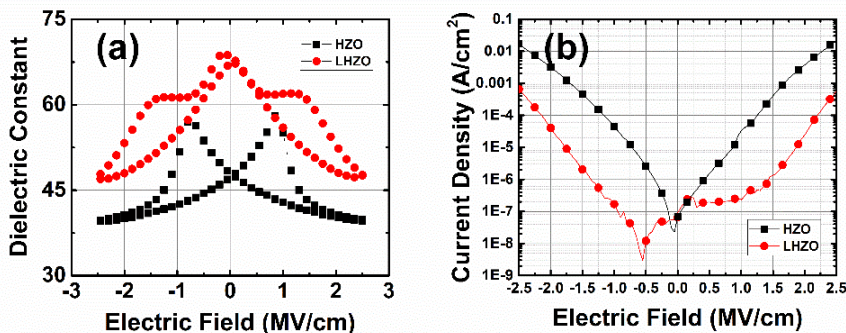


Figure 2. (a) small signal capacitance-electric field curves and (b) leakage current density-electric field curves of $\text{Hf}_{0.5}\text{Zr}_{0.5}\text{O}_2$ and La-doped $\text{Hf}_{0.5}\text{Zr}_{0.5}\text{O}_2$ (LHZO).

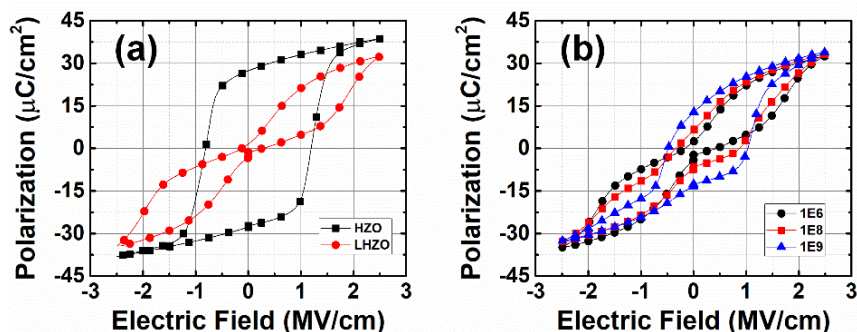


Figure 3. Polarization-Electric field (P-E) hysteresis result of $\text{Hf}_{0.5}\text{Zr}_{0.5}\text{O}_2$ (HZO) and La-doped $\text{Hf}_{0.5}\text{Zr}_{0.5}\text{O}_2$ (LHZO). (a) antiferroelectric property is shown after La doping in HZO, (b) the remnant polarization ($2P_r$) is recovered after 10^8 endurance cycles. In particular, $2P_r$ for LHZO is $26 \mu\text{C}/\text{cm}^2$ after 10^9 endurance cycles.

¹ A.G. Chernikova, et al., ACS Appl. Mater. Interface **10**, 2701 (2018).

² S.V. Ushakov, et al., J. Mater. Res. **19**, 693 (2004).

³ S.E. Reyes-Lillo, et al., Phys. Rev. B **90**, 140103(R) (2014).