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A new fundamental limit of ferroelectric devices and its domain dynamics in ultrathin ferroelectric $BaTiO_3$ films J.Y. JO, D.J. KIM, Y.S. KIM, T.W. NOH, ReCOE & School of Physics,Seoul National University, Seoul 151-747, Korea, T.K. SONG, Department of Ceramic Science and Engineering, Changwon National University, Changwon, Kyungnam 641-773, Korea, J.-G. YOON, Department of Physics, University of Suwon, Gyunggi-do 445-743, Korea — Phenomena in ultrathin ferroelectric (FE) films, such as the critical thickness and the domain structures, have attracted much interest for a few years. We fabricated fully-strained $SrRuO_3/BaTiO_3/SrRuO_3$ capacitors, whose $BaTiO_3$ layer thicknesses were between 5 and 30 nm, using the laser molecular beam epitaxy. We found that rapid decay of net polarization occurs due to large depolarization field [1]. Using the Monte-Carlo simulations, this decay can be explained by the domain formation dynamics, governed by the domain nucleation process. We found a universal relation between the decay exponent and nucleation energy barrier, regardless of film thickness and temperature. This universal relation will provide a fundamental thickness limit for practical FE devices, set by net polarization decay. [1] D. J. Kim et al. Phys. Rev. Lett, in press.

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