Understanding ferroelectric phase formation in doped HfO$_2$ thin films based on classical nucleation theory

Min Hyuk Park$^a$, Young Hwan Lee$^b$ and Cheol Seong Hwang$^{b,*}$

a. School of Materials Science and Engineering, Pusan National University, 2 Busandaehak-ro-63beon-gil, Geumjeong-gu, Busan 46241, Republic of Korea.

b. Department of Materials Science and Engineering & Inter-University Research Center, College of Engineering, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul 08826, Republic of Korea.
Figure S1. Changes in activation energy divided by kT at various temperature for phase transition from amorphous phase to x-phase for doped HfO$_2$ films with Y content of (a) 0, (b) 1.04, (c) 2.08, (d) 3.125, (e) 4.16, (f) 5.20, (g) 6.25, and (h) 7.29 cat%. x can be tetragonal (t), monoclinic (m), and orthorhombic (o) phase.
Figure S2. Changes in activation energy divided by kT at various temperature for phase transition from x-phase to y-phase for doped HfO2 films with Y content of (a) 0, (b) 1.04, (c) 2.08, (d) 3.125, (e) 4.16, (f) 5.20, (g) 6.25, and (h) 7.29 cat%. x and y can be tetragonal (t), monoclinic (m), and orthorhombic (o) phase.