Electric field induced domain evolutions in $BaTiO_3$ single crystal

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Abstract:

We present an *in-situ* transmission electron microscopy investigations on 90º ferroelectric domains switching in $BaTiO_3$ single crystals, using a special homemade transmission electron microscopy stage and applying an electric-field perpendicular to the electron beam on the sample surface. The polarity vectors of ferroelectric domains are determined by convergent-beam electron diffraction successfully. Three domain switching courses are investigated. When the polarity vectors of matrix along the direction of external field, the evolutions are the shrinking of domains and expanding of matrix. When the polarity vectors of domains are antiparallel to the direction of electric field, new domains 90º away are observed to occur with the initial domains gradually disappearing. The polarizations of the new domains are switched to the direction of the external electric field. When the polarity vectors of matrix are antiparallel to the direction of electric field. A two-step domain switching mechanism is observed: at the first stage, the polarization vectors of the matrix rotated 90º through domain wall movement and new domains nucleation; Then, the other 90º rotation happened and finally all the polarization vectors of the domains rotated to the direction of the external field, the multi-domains become a monodomain in a short time. X-ray techniques were used to determine the phase structure and components of the specimen in this work.