Domain structure of $BaTiO_3$ ceramics before and after poling

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Barium titanate ($BaTiO_3$, BTO) is a extensively studied ferroelectric with large polarizations and dielectric permittivity [1]. As a lead-free environmentally friendly material it considered as a candidate for capacitors, resistors with positive temperature coefficient, ultrasonic transducer and piezoelectric devices [2]. BTO at room temperature has tetragonal distorted perovskite unit cell allowing to consider it as a model material for studying the domain structure evolution in electric field [1]. The domain walls significantly impact to macroscopic properties [3, 4]. Piezoelectric performance can be estimated to be above 70% and consists contributions of reversible and irreversible wall motion [5, 6] in heterogeneous multiaxial materials of grain and phase boundaries and defects [7]. The role of grain boundaries in polarization reversal has not been understood despite of long study. Thus, the microscopic studies of domain structure and local piezoelectric response in BTO ceramics by piezoresponse force microscopy (PFM) and complimentary methods is useful for understanding the polarization reversal in polycrystalline materials. The BTO ceramics sintered by conventional solid-state path was studied by 3D-PFM to determine polarization direction in individual grains [8]. The domain structure imaging before and after poling allowed to study the domain evolution during polarization reversal. Complementary electron backscattered diffraction mapping was used for inspecting sizes and orientations of grains. The domain wall motion and interaction with grain boundaries are discussed and conditions for transgranular domain formation are formulated.

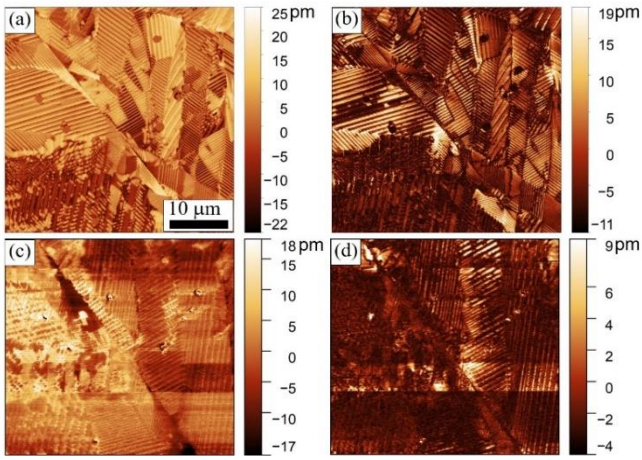

Figure 1. PFM domain images in BTO: (a,c) vertical and (b,d) lateral piezoresponse, (a,b) before and (c,d) after poling.

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