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In situ high-energy x-ray diffraction study on bulk bismuth ferrite ceramic

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Bismuth ferrite, BiFeO₃ (BF) is a multiferroic ceramic familiar for the existence of both strong ferroelectric and magnetic ordering at room temperature. In addition to the multiferroicity, the remarkably high Curie temperature (T_c) and spontaneous polarization (P_s) of BF has made it an attractive candidate to replace lead-based Pb(Zr,Ti)O₃ for industrial applications. However, the high coercive field (> 10 kV.mm⁻¹) and related poling inefficiency is the major issue for the application of BF as a piezoelectric material. To tailor the actuator property of bulk BF ceramic, it is essential to understand the structure-property relationship in the ceramic at field-on condition. In situ high-energy x-ray diffraction measurements with a large area detector in transmission geometry can be utilized to quantify the structural variation with field in these materials. Here, we used the high-energy x-ray diffraction beamline I12-JEEP of the Diamond Light Source, UK. Qualitative and quantitative analysis of diffraction patterns reveal that ferroelastic domain switching is the primary mechanism for the strain response. Interestingly, a strain magnitude similar to thin film BF was observed; however, the origin of strain response is different.

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