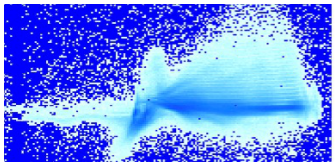

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# Piezoelectric response in PMN relaxor ferroelectric probed by in-situ wide-angle X-ray Photon Correlation Spectroscopy

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The development of advanced functional materials relies on understanding interactions and heterogeneity at nanometer-to-micrometer length scales. The extraordinary electromechanical properties of relaxor ferroelectrics are widely attributed to the crucial role of spatial structural heterogeneity. Recent developments in coherent x-ray sources and methods significantly advance the possibilities of nanoscale measurements, offering superb spatial and temporal resolution, and support also in-situ type experimental techniques. Wide-angle X-ray photon correlation spectroscopy (XPCS) is a powerful tool to probe dynamics of heterogeneity in condensed matter, both in equilibrium and under applied stimuli [1,2]. Here, we present an in-situ XPCS study of the relaxor ferroelectric PbMg1/3Nb2/3O3 (PMN) under applied AC electric field [3]. We observed strong periodic response in two-time correlation function (TTCF) calculated from the diffuse scattering speckle pattern, even for relatively weak applied AC fields. This is surprising since PMN is electrostrictive, with no linear piezoelectric response at zero field. The periodic behavior in the TTCF was shown to arise from local tilting of the illuminated sample volume due to the combined AC field and a static field caused by the incident X-ray beam. To qualitatively describe the results (tilt amplitude and direction) we developed a model that combines the electrostrictive response of the PMN material and the non-uniform charging due to the incident micrometre-scale X-ray beam. The X-ray-induced piezoresponse may play a crucial role in interpreting XPCS and nanodiffraction studies on other insulating materials subjected to applied AC fields or varying X-ray illumination.

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