X-ray Coherent Diffraction Study of the Nanodomain formation in the PMN-10%PT Relaxor

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We have successfully measured the temperature dependence of the speckle patterns from the PMN-10%PT relaxor. The formation of the regular domain structure and the gradual time evolution of the domains were observed.

Keywords : nanodomain, coherent x-ray, PMN-10%PT, relaxor

1. Purpose

The formation of the Polar Nano Regions (PNRs) is the key point for the understanding of the relaxor phenomena. The existing data on the PNR are usually obtained for the very thin layers (HREM) or in the strong electric field (PFM). To study the process of the formation and development of the PNRs we have performed the X-ray coherent diffraction study of the $(PbMg_{1/3}Nb_{2/3}O_3)_{0.9}(PbTiO3)_{0.1}$ (PMNPT10) solid solution.

2. Method

The platelet shaped single crystal was mounted in the cryostat placed on the four-circle goniometer of the BL22XU beam line. CCD camera was used to observe the speckle pattern.

3. Result

Measurement were carried out at and near the (200) reciprocal lattice point in the temperature region 200K≤T≤370K. Speckle patterns were clearly seen at 300K and 320K evidencing the existing of the PNRs. In the self-correlation function clear peaks related to the regular arrangement of the PNRs were observed. On heating up to 370K speckles disappear. On cooling below 300K the peaks in the Fourier transform were smoothed probably due to the strong critical fluctuations. On further cooling new systems of the peaks developed that can be attributed to the formation of the regular domain structure. Successive measurements of the speckle pattern at 230K for 6 hours have revealed the gradual time evolution of these domains.

4. Conclusion

We have successfully measured the temperature dependence of the speckle patterns from the PMN-10%PT relaxor. The formation of the regular domain structure and the gradual time evolution of the domains were observed.

5. Reference