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Composition dependence of the diffuse scattering in relaxor (1-x)$\mathbf{Pb(Mg_{1/3}Nb_{2/3})O_3}$-$x\mathbf{PbTiO_3}$ ($0 \leq x \leq 0.40$) M. MATSUURA, K. HIROTA, ISSP The University of Tokyo, P. M. GEHRING, NIST Center for Neutron Research, ZUO-GUANG YE, W. CHEN, Department of Chemistry Simon Fraser University, G. SHIRANE, Deapartment of Physics Brookhaven National Laboratory — We have studied composition dependence of diffuse scattering in the relaxor system (1-x)$Pb(Mg_{1/3}Nb_{2/3})O_3$-$xPbTiO_3$ (PMN-xPT) with x = 0, 10, 20, 30, and 40% by neutron diffraction. The addition of ferroelectric $PbTiO_3$ (PT) modifies the "butterfly" and "ellipsoidal" diffuse scattering patterns observed in pure PMN ($x = 0$), which are associated with the presence of randomly oriented, polar nanoregions (PNR). The spatial correlation length ξ derived from the width of the diffuse scattering increases from 12.6 Å for PMN ($x = 0$) to 350 Å for PMN-20%PT, corresponding to an enlargement of the PNR. The integrated diffuse scattering intensity, which is proportional to χ'', grows and reaches a maximum at x = 20%. Beyond x =30% PT, a concentration very close to the morphotropic phase boundary (MPB), no diffuse scattering is observed below T_C, and well-defined critical behavior is observed. By contrast, the diffuse scattering for $x \leq 20\%$ persists to low temperatures, where the system retains an average cubic structure ($T_C = 0$). We can simulate the wave vector dependence of the diffuse scattering by assuming that it arises from the condensation of a soft transverse-optic (TO) phonon.

Masato Matsuura
ISSP The University of Tokyo

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