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Structured diffuse scattering and polar nano regions in the Ba(Ti1-xSnx)O3 relaxor ferroelectric system

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Compositionally disordered relaxor ferroelectric systems with their significantly broadened (relative to that of normal ferroelectric materials) but still high magnitude peaks in dielectric permittivity as a function of temperature, have long been of intense and continuing interest. The observation via electron diffraction of relatively sharp, G ± {001}* sheets of diffuse intensity arising from the large amplitude excitation of inherently polar, transverse optical modes of distortion in Ba(Ti1-xSnx)O3 (BTS), $0.1 < x < 0.5$, samples, both at room temperature as well as liquid nitrogen temperature, shows that the polar nano regions (PNRs) in these relaxor ferroelectric materials correspond to the same highly anisotropic chain dipoles as are characteristic of the normal ferroelectric end member BaTiO3 itself. The correlation length along the chains of these 1-D PNR's is estimated to be at least 5 nm even for the higher x samples. The role of the dopant Sn ions is not to directly induce PNR's but rather to set up random local strain fields preventing the condensation of long wavelength homogeneous strain distortion of the unit cell thereby suppressing transverse correlations of the chain dipoles and the development of long range ordered ferroelectric state/s.