Central peak in the vibrational spectrum of the relaxor ferroelectric

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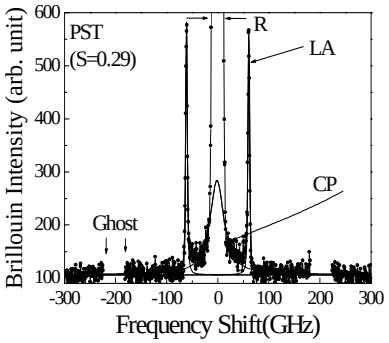
Relaxor ferroelectrics are a wide family of perovskite-like ferroelectrics with diffuse phase transition with the general formula $AB'B''O_3$. A characteristic feature of the lattice dynamics of these compounds is a broad anomaly of the frequency-dependent dielectric response (up to 300 degrees as in $PbMg_{1/3}Nb_{2/3}O_3$ -(PMN)) arising on transformation into the ferroelectric state. $PbSc_{1/2}Ta_{1/2}O_3$ -(PST) crystals are convenient model objects for studies of properties of relaxors because the disorder degree of these compounds can be increased by heat treatment. The dielectric response of PST changes in this case from a broad anomaly (100 degrees) in disordered samples to a "classical" narrow anomaly in ordered samples. In the papers concerned with low-frequency light scattering in relaxors was shown that a characteristic feature of the vibrational spectrum of relaxor ferroelectrics is a central peak[1-3]. In the absence of a soft mode, the relaxation mode (which appear in light scattering spectra as a central peak or quasielastic scattering) can play a key role in the lattice dynamics. In this report we present the results obtained in Raman and micro-Brillouin studies of the low-frequency region of the vibrational spectrum of relaxor ferroelectrics PST and PMN in the temperature interval from 80 to 650 K.

A typical Brillouin spectrum at room-temperature for a PST crystals is shown in Fig. It can be seen that an additional contribution at an unshifted frequency described by the Lorentz function is present. Dots are experimental data, lines represent fitted longitudinal acoustic modes (LA) and central peak (CP), respectively. Except the longitudinal acoustic mode, a broad central peak is directly observed. It is important to note that quasielastic scattering in PST and PMN is polarized, and it is absent in Brillouin spectra with polarization VH. Central peaks are likely common features for all relaxor ferroelectrics. In our report we discuss temperature dependences of FWHM and quasielastic scattering intensity obtained by fitting the experimental spectra of PST and PMN crystals. It can be seen that as the sample is cooled, a broad central peak with a low intensity at high temperatures becomes narrower, and its intensity grows. Monotonic changes in temperature dependences are followed by sharp anomalies in the vicinity of 290 K.

It is shown that light scattering spectra of the relaxor ferroelectrics have a quasielastic contribution consisting of two components: wide (HWHM ≥ 30 cm^{-1}) and narrow (HWHM ~ 0.5 cm^{-1}). Comparison of micro-Brillouin spectra obtained for samples PST with different order degrees and PMN did not reveal substantial changes in the central peak parameters. Temperature dependences of intensity and width of the central peak of PST exhibit a broad anomaly corresponding to the maximum of the dielectric response and a narrow anomaly. Possible reasons for anomalous temperature evolution of the central peak are discussed.



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