Electric field effect on ferroelectric phase transition of Li-doped KTa_{1-x}Nb_xO₃ single crystals studied by Brillouin scattering

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Among the large family of the perovskite ferroelectrics, the KTa_{1-x}Nb_xO₃ (KTN) has attracted a great deal of attention because of their high electro-optical coefficients, which make them one of the promising materials for the applications to optical-devices [1]. Recently, the relaxor natures of high quality KTN single crystals were studied by acoustic emission (AE) and Brillouin scattering measurement [2,3]. Due to giant electromechanical response in the vicinity of the critical end point (CEP) [4], the study of the temperature-field phase diagrams is the current topic in materials science. In this study, electric field effect on the ferroelectric phase transition of Li-doped KTN single crystals was investigated by Brillouin scattering and dielectric measurements. The remarkable changes of the central peak (CP) intensity were observed as shown in Fig. 1(a), indicating the paraelectric cubic to ferroelectric tetragonal phase transition. However, the frequency of transverse acoustic (TA) phonon began to soften at the critical electric fields. The critical electric fields to induce the paraelectric to ferroelectric phase transition were found to shift to higher values with increasing temperature. From these CP results, we estimated lines of critical points for phase transitions including CEP, (*E*, *T*) = (1.6 kV/cm, *T*_C+3.4 °C) in the composition-temperature-electric field (*x*-*T*-*E*) phase diagram as shown in Fig. 1(b). At the electric fields, *E*_{C1} and *E*_{C2}, the ferroelectric to paraelectric phase transition on cooling and the paraelectric to ferroelectric phase transition on cooling and the paraelectric to ferroelectric phase transition.



Fig. 1 (a) Electric field dependence of the CP intensity of a Li-doped KTN at some selected temperatures and (b) temperature dependence of the phase transition electric fields of a Li-doped KTN single crystal.
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