	Experiment title: **Lattice dynamics of relaxor-like ferroelectric perovskite $K(Ta,Nb)O_3$**	**Experiment number**: HC-3111
Beamline: ID28	**Date of experiment**: from: 17/05/2017 to: 22/05/2017	**Date of report**: 30/05/2017
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Report:

Summary

The aim of this proposal was to study the lattice dynamics of potassium tantalate niobate ($KTa_{1-x}Nb_xO_3$ – KTN, with x = 0.35) using a combined technique of thermal diffuse scattering (TDS) and inelastic X-ray scattering (IXS). KTN is a relaxor-like ferroelectric material which exhibits a giant electro-optic effect upon applying a relatively weak electric field, thus making this material very interesting for variable applications in visible optics. There is still controversy about the origin of phase tranformation in KTN, i.e from cubic paraelectric to tetragonal ferroelectric phase. It is thus interesting to investigate the lattice dynamics of this compound regarding phonon modes across the phase transitions.

Experiment

KTN single crystal was cut to a needle-like shape with 50 mkm diamenter and 1 mm long. TDS data were collected on ID28-Side station with an incoming beam energy of 17.794 keV. The sample was cooled using liquid nitrogen-based Oxford Cryostream. TDS maps were reconstructed using CrysAlis software available on the beamline in order to shed light on interest region where one can see strong diffuse intensity which probably reveals soft phonons or static disorder contribution. The sample was then transferred to the IXS

spectrometer for phonon measurement. The spectrometer was operated at 17.794 keV using a multilayer focusing scheme giving a beamsize of 30x60 mkm and a resolution of 3.0 meV. 6 constant-q scans were recorded in the two directions <0 2 0> and <2 0 0> to probe the transverse acoustic phonons at a given temperature. A total of 10 temperatures data were measured.

Results

As a preliminary result, we could observe a strong softening of the transverse acoustic (TA) phonon across the transition temperature (282 K) – as shown on figure 1.

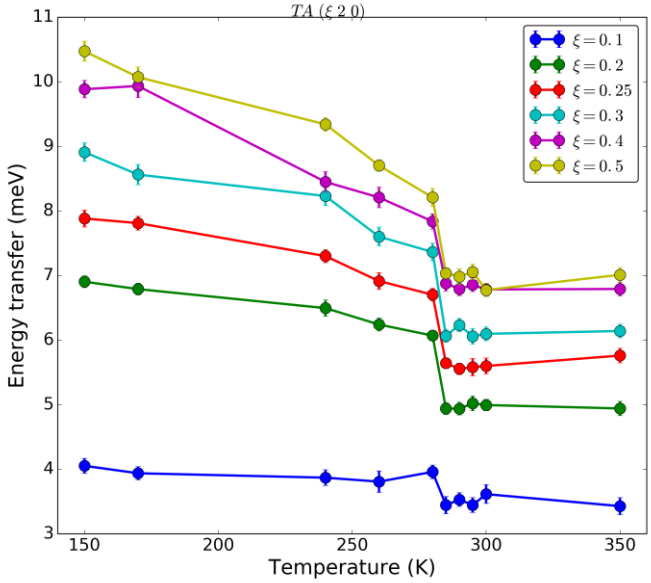

Figure 1: TA phonon energy as a function of temperature.

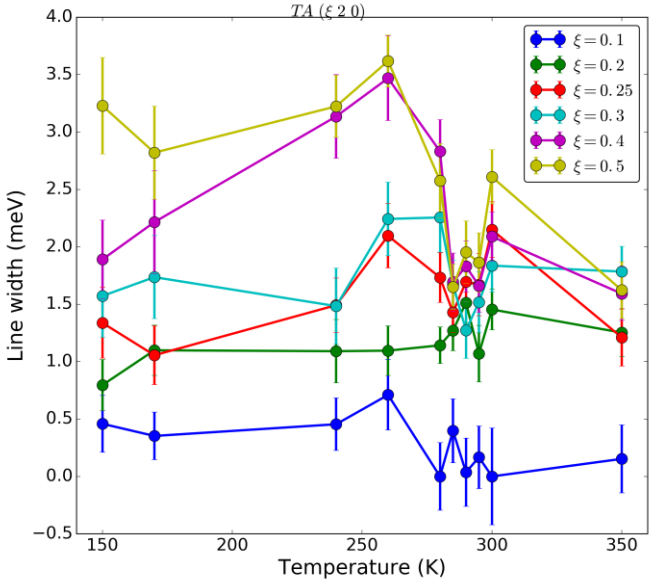

Figure 2: TA line width as a function of temperature.

Another effect is the overdamping of this phonon across the phase transition, presenting by the broadening of the phonon line width, as shown on figure 2. This broadening is more remarkable toward the zone boundary ($\xi = 0.4$ and $\xi = 0.5$ in this figure). This feature is not observed in the second direction (i.e <2 0 0>), which indicates an anisotropy and non equivalent in term of lattice dynamics in these two directions.
These interesting results would be considered for interpretation of the origin of phase transition in KTN, in comparison with KNbO3 parent compound.