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Among complex perovskite-type structure multiferroics $[A(B'B'')\text{O}_3]$, lead iron niobate $\text{Pb}(\text{Fe}_{1/2}\text{Nb}_{1/2})\text{O}_3$ (PFN) discovered by Smolenskii *et al.*¹ is currently of interest because of its high dielectric constant diffuse phase transition² and magnetoelectric effect^{3,4}. PFN presents ferroelectric transition below $T_C \sim 350\text{-}395$ K and antiferromagnetic transition below $T_N \sim 145$ K¹⁻⁴.

In PFN, the Pb^{2+} cations with a lone electron pair in A site and the relative displacements of oxygen and $\text{Fe}^{3+}/\text{Nb}^{5+}$ ions in the octahedral B sites favor the electric ordering whereas the Fe^{3+} cations with partially filled d orbitals contribute to the magnetic ordering. Because of its complex structure, still exists a disagreement about the crystalline structure of PFN: monoclinic (space group Cm), rhombohedral (space group $\text{R}\bar{3}\text{m}$), and cubic (space group $\text{Pm}\bar{3}\text{m}$) structure symmetry at room temperature were reported^{3,5,6}.

In this work, we report temperature-dependent Raman spectra (10-500 K) in the frequency range of $150\text{-}1250$ cm^{-1} of cubic PFN single crystals, complemented with magnetization measurements. We want to provide microscopic information in this material.

Over the range from 150 to 950 cm^{-1} , very broad and overlapping peaks (first-order character) were observed in the overall studied temperature range possibly due to local distortions which are characteristic in this kind of Pb-based complex perovskite. Also, a prominent high-frequency peak at ~ 1130 cm^{-1} , which we assign as a two-phonon peak, was observed (see Fig. 1).

Temperature dependence of the Raman spectra showed an anomaly in a characteristic temperature $T^* \sim 330$ K. Here, drastic changes in the Raman scattering intensity and spectral shape were observed with temperature variations, such as the appearance of new first- and second- order peaks below T^* . The temperature behavior of the two-phonon peak shows a strong electron-phonon interaction in PFN. Also, since it was reported weak magnetic ordering at and even above room temperature in

this material, the anomaly at $T^* \sim 330$ K by Raman scattering could be possibly suggesting an interplay between magnetic e ferroelectric orders.

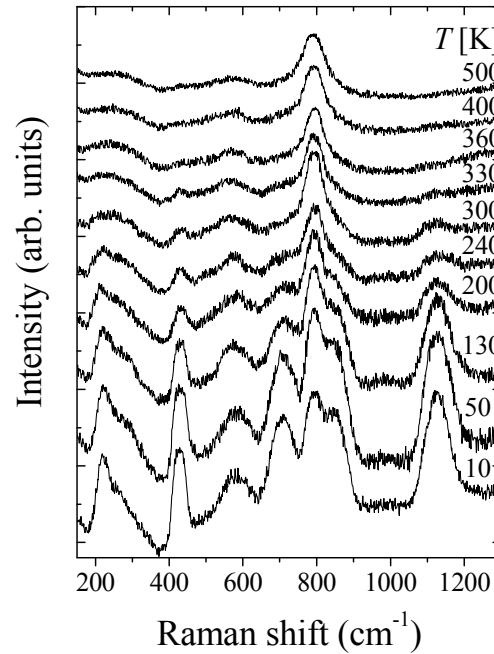


Figure 1: Raman spectra as a function of temperature in $\text{Pb}(\text{Fe}_{1/2}\text{Nb}_{1/2})\text{O}_3$.

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