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Raman Scattering Study of Low Frequency Phonon Polaritons in Barium Sodium Niobate

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The investigation of phonon polaritons by near forward Raman scattering technique have proved to be a powerful method of obtaining infromation about a lot of physical properties, for example dielectric properties. On the other hand, the recent development of concave holographic gratings with a high stray light rejection enables measurements of very low frequency phonon polaritons at very small angles without filter techniques.

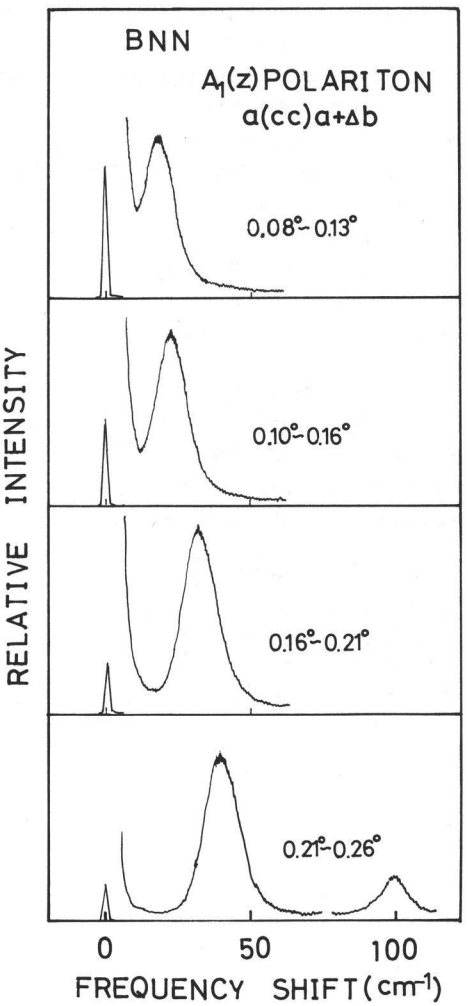

Fig. 1. Polariton spectra for different angles. Polariton peaks are clearly observed in the vicinity of Rayleigh line.

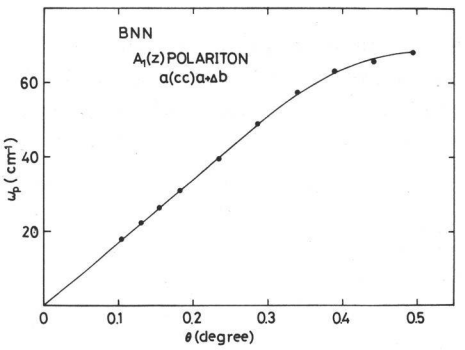

Fig. 2. Angular dispersion of polariton frequency ω_p.

Barium sodium niobate $Ba_2NaNb_5O_{15}$ (abbreviated as BNN) is one of the crystals of technological importance with tungsten-bronze structure. It undergoes a ferroelectric transition about 560°C and has a spontaneous polarization along the c-axis.[1] The polariton dispersion relation of $A_1(z)$ symmetry has been investigated utilizing the near forward Raman scattering with the scattering geometry $a(cc)a+\Delta b$. Obtained spectra are shown in Fig. 1. Polariton peaks were clearly observed above 0.08° even in the vicinity of the laser line frequency. The angle in the crystal is calculated by the Snell's law. It shows a normal dispersion of phonon polaritons as shown in Fig. 2. No effect of the coupling between photon and relaxers has been observed. The low frequency clamped dielectric constant determined by the equation $\omega/q=\sqrt{\varepsilon_3^{(0)}}$ is $\varepsilon_3=26.6\pm0.3$, which is consistent with the previous data $\varepsilon_3=30\pm5$ obtained by G. Burns.[2]

References

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