

Polarized Raman and IR spectra of the orthorhombic $\text{CaNb}_2\text{O}_6:\text{Pr}^{3+}$ single crystal

L. Macalik¹, M. Mączka¹, J. Hanuza^{1,2} and A.A. Kaminski³

¹Institute of Low Temperature and Structure Research, Polish Academy of Sciences P.O. Box 1410, 50-950 Wrocław, Poland, ²Department of Bioorganic Chemistry, Faculty of Engineering and Economics, Wrocław University of Economics, 118/120 Komandorska str., 53-345 Wrocław, Poland, ³Joint Open Laboratory for Laser Crystals and Precise Laser Systems, Institute of Crystallography, Russian Academy of Sciences, Moscow, Russia l.macalik@int.pan.wroc.pl

A high optical quality columbite $\text{CaNb}_2\text{O}_6:\text{Pr}$ single crystal doped with 0.5 at. % of Pr^{3+} ions has been grown by Czochralski method. The orientation of the crystallographic axes has been done using X-ray method. The orientation of the $x \parallel \mathbf{a}$, $y \parallel \mathbf{b}$ and $z \parallel \mathbf{c}$ axes has been used for the unit cell Pbcn with lattice parameters: $\mathbf{a} = 14.926 \text{ \AA}$, $\mathbf{b} = 5.752 \text{ \AA}$ and $\mathbf{c} = 5.204 \text{ \AA}$ and $\alpha = \beta = \gamma = 90^\circ$ [1].

The polarized Raman spectra of this crystal in the $z(\text{xx})z$, $z(\text{yy})z$ and $y(\text{zz})y$ geometry for A_g , $z(\text{yx})z$ for B_{1g} , $y(\text{zx})y$ for B_{2g} and $x(\text{yz})x$ for B_{3g} have been measured. Polarized IR spectra of the single crystal have been measured in the $E \parallel y$ and $E \parallel z$ geometry using a fixed-angle specular reflectance accessory. The discussion of the results has been based on the factor group approach for the orthorhombic Pbcn (D_{2h}^{14}) space group with $Z = 4$. The analysis of the vibrational characteristics of the NbO_6 distorted octahedra and CaO_6 units has been made on the basis of the literature data [2].

The columbite crystal is a prospective Raman laser. The results obtained for the spontaneous Raman scattering have been used in the discussion of the stimulated Raman spectra of the material studied. Among the modes observed in the fully symmetric A_g Raman spectra the strongest line appears at 904 cm^{-1} that corresponds to the symmetric $\nu_s(\text{NbO}_6)$ mode. This mode is expected to participate in the stimulated Raman effect as the promoting vibration.

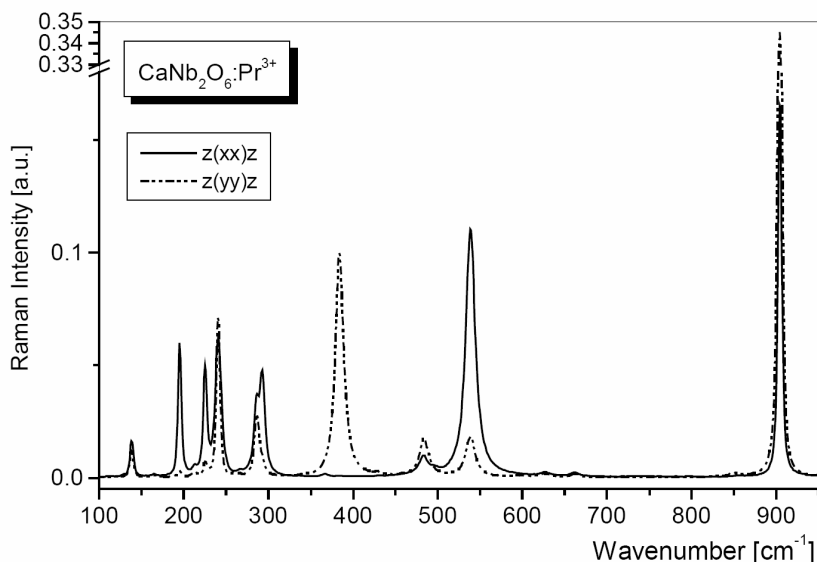


Fig. 1: A_g Raman spectra of $\text{CaNb}_2\text{O}_6:\text{Pr}$ single crystal.

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[2] E. Hudson, Y. Repelin, N.Q. Dao, H. Brusset, *J. Chem. Phys.* 66 (1977) 5173.