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Raman spectroscopy study of phase transitions in Loparite

E. Popova (1,2,3), S. Chillal (1), D. Hüvonen (1), S. Lushnikov (2), S. Krivovichev (3), and A. Zheludev (1)

(1) Neutron Scattering and Magnetism, Laboratory for Solid State Physics, ETH Zurich, Switzerland , (2) A.F. Ioffe Physical Technical Institute RAS, 194021 St. Petersburg, Russia, (3) St. Petersburg State University, Crystallography Department, St. Petersburg, Russia

Loparite-Ce (Na,Ce)(Ti,Nb)O_3 is a natural mineral from the well-known perovskite group with common formula ABO_3. Minerals of the perovskite group are accessory in the Earth's crust, whereas the low mantle consists of minerals transformed mostly into perovskite structure type under high-pressure conditions. Investigations of phase transitions in complex compounds with perovskite structure are necessary to understand of material transformations in depth of the Earth.

An ideal perovskite structure is cubic, Pm3m. It consists of a framework of corner-sharing BO_6 octahedra, with cuboctahedral cavities occupied by the A-site cations. Different types of octahedra tilting are repsonsible for distortions and the subsequent reduction symmetry, which is typical for naturally occurring minerals with complex composition. Small deviations from cubic structure cannot be revealed by X-ray diffraction only, and a detailed spectroscopic studies may help to identify changes in local symmetry, for which Raman scattering is the most helpful.

This report presents results of a Raman spectroscopy study of single crystals of loparite from the Khibiny alkaline massif, Kola Peninsula (Russia). Polarized Raman spectra were recorded in the temperature range of 10 - 300 K with the incident light polarized along (100]). Inelastic light scattering experiments were performed at a triple grating Raman spectrometer Trivista 557 with a green laser (532 nm) in the 1800 scattering geometry.

Analysis of temperature evolution of loparite Raman spectra shows two anomalies (around 150K and 220K) registered by changes in the temperature behaviour of the low-energy modes and quasielastic scattering. Results of additional investigations of loparite dielectric response, heat capacity measurements and X-Ray diffraction experiments are in good agreement with the temperature evolution of Raman spectra.