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Phase transitions in perovskite-like fluorides studied by Raman spectroscopy

Krylova S.[a], Krylov A.[a], Voronov V.[a] and Vtyurin A.[a]

[a] *Akademgorodok 50/38, Krasnoyarsk, 660036, L. V. Kirensky Institute of physics SB RAS, Russia, slanky@iph.krasn.ru*

Since the discovery of Raman phenomenon the Raman spectroscopy has been considered as an efficient technique to study the structure and lattice dynamics of crystals. The creation of the monochromatic radiation laser sources has revolutionized this classical field of vibrational spectroscopy and provided an impetus to create new ones. It is established that inelastic light scattering contains valuable information on the crystal structure, phonon spectrum, mechanisms of electron-phonon and phonon-phonon interactions. Obtaining this information is an important task of the solid state spectroscopy. Such experiments are necessary to investigate new crystalline materials and structures. During last decades many crystals with a complex structure were synthesized. They became new objects of fundamental solid-state physics as the perspective materials for practical use. There is a perovskite-like family including perovskites, elpasolites, layered perovskites, cryolites and other crystals with octahedral molecular ions. Perovskites are model objects to study phase transitions in crystals. The family includes the majority of modern inorganic materials applied in nonlinear optics and quantum electronics. Some of the perovskite-like materials are ferroelectrics, piezoelectrics or superconductors. This work shows the possibilities of Raman spectroscopy with reference to the phase transition investigations of some perovskite-like fluorides. It is shown that Raman spectroscopy provides the opportunity for understanding the phase transition mechanisms and estimating the behavior of ion groups at phase transition. It is shown by Raman spectroscopy that the temperature transitions from cubic into low symmetry phases in Rb_2KScF_6, Rb_2KInF_6, Rb_2NaYF_6 crystals result from the lattice instability caused by the MeF_6^{3+} octahedral ion tilting [1, 2]. The experimental data and results of the numerical simulations reveal that the phase transitions in the Rb_2KTiOF_5 crystal are due to the orientational ordering of the $TiOF_5$ groups, but new phases remain partially disordered as well [3]. The temperature phase transitions in the $(NH_4)_2WO_2F_4$ crystal are caused by the ordering of molecular quasi-octahedral groups $[WO_2F_4]^{2-}$ and ammonium groups [4].

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