

## Experimental manifestations of the Nb<sup>4+</sup>-O<sup>-</sup> polaronic excitons in KTa<sub>0.988</sub>Nb<sub>0.012</sub>O<sub>3</sub>

Yusupov R., Gracheva I., Rodionov A., Surnikov P., Gubaev A., Dejneka A., Jastrabik L., Trepakov V., Salakhov M.

Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

---

### Abstract

The formation of the photopolaronic excitons in ABO<sub>3</sub> perovskite-type oxides has been detected experimentally by means of the photoinduced electron paramagnetic resonance (EPR) studies of KTa<sub>0.988</sub>Nb<sub>0.012</sub>O<sub>3</sub> crystals. The corresponding microwave x-band spectrum at  $T < 10$  K consists of a narrow, nearly isotropic signal located at  $g \sim 2$  and a strongly anisotropic component. The first signal, which has a rich structure due to hyperfine interactions with the lattice nuclei, is attributed to the single trapped charge carriers: the electrons and/or the holes. The anisotropic spectrum is caused by the axial centers oriented along the C<sub>4</sub> pseudocubic principal crystalline axes. The spectrum angular dependence can be described well by an axial center with  $S = 1$ ,  $g = 0.82$ ,  $g = 0.52$ , and  $D = 0.44$  cm<sup>-1</sup>. The anisotropic spectrum is attributed to the Nb<sup>4+</sup>-O<sup>-</sup> polaronic excitons. The temperature dependence of the anisotropic component is characterized by two activation energies: the internal dynamics activation  $E_{a1} = 3.7 \pm 0.5$  meV, which makes the EPR spectrum unobservable above 10K, and the destruction energy  $E_{a2} = 52 \pm 4$  meV. By comparing the anisotropic photo-EPR spectrum and the photoinduced optical absorption temperature dependencies, we found that the Nb<sup>4+</sup>-O<sup>-</sup> polaronic excitons also manifested themselves via the wide absorption band at  $\sim 0.7$  eV arising under ultraviolet light excitation in the weakly concentrated KTaO<sub>3</sub>:Nb crystals. © 2011 American Physical Society.

<http://dx.doi.org/10.1103/PhysRevB.84.174118>

---