Polaronic Excitons in KTN: Optical Absorption and Photo-EPR Manifestations.

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The "quantum paraelectrics" $KTaO_3$ and $SrTiO_3$ can be considered as systems close to the quantum mechanical limit at low temperatures. In such systems, *unlike in the classical case*, the phase transitions can be achieved by tuning not the temperature, but the other parameters, such as pressure, electric and magnetic field, chemical composition, impurity doping. The giant photodielectric effect recognized in $SrTiO_3$ and $KTaO_3$ [1-3], where UV light irradiation at low temperatures strongly enhances the dielectric constant is another example. Qualitatively, this phenomenon has been assigned to the inhomogeneous polar state induced by photocharge carriers, but understanding of their microscopic nature had not been achieved.

We report on results of low-T studies of optical absorption and photo-EPR of KTN ($KTa_{1-x}Nb_xTaO_3$, x=0.004÷0.02) crystals. It was found that UV light irradiation results in a broad absorption band in NIR region. Together with photoconductivity and photoluminescence experiments it provides the broad hint of strong localization of the charge carriers in the form of Nb^{4+} electronic polarons. Strict verification and characterization of photo-polaronic states is provided by the x-band photo-EPR experiments. So, photo-EPR spectrum of KTN with x = 0.012 reveals the anisotropic component originated from the axial centres with S = 1, $g_{||}$= 0.82±0.04, $g_{\perp}$=0.52 ± 0.04, and D = 0.44 ± 0.03 cm^{-1} attributed to the polaronic excitons Nb^{4+}-O^- with activation energy E_{a1} ~ 3.7 meV for internal dynamics and destruction energy E_{a2} ~ 52 meV. Namely Nb^{4+}-O^- polaronic excitons manifest themselves via the wide absorption band at ~0.7 eV, which arises in the KTN under UV illumination.

References

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