

## Effect of sample illumination on the content of luminescence active defects in Sn<sub>2</sub>P<sub>2</sub>S<sub>6</sub> crystals

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Tin hypthiodiphosphate Sn<sub>2</sub>P<sub>2</sub>S<sub>6</sub> is promising uniaxial semiconductor ferroelectrics with favorable photorefractive properties in the red and near-infrared spectral regions, a pronounced photoconductivity, and large values of pyroelectric, piezoelectric, and electrooptic coefficients. Moreover, Sn<sub>2</sub>P<sub>2</sub>S<sub>6</sub> crystals exhibit photoluminescence (PL) in the red and near-infrared spectral regions at low temperatures that is related to intrinsic crystal defects [1]. In comparison to conventional orange tinted crystals the photorefractive properties of brown tinted Sn<sub>2</sub>P<sub>2</sub>S<sub>6</sub> crystals were improved by modification of crystal growth conditions and they are not noticeably sensitive to crystal pre-illumination as well. However, the nature of defects involved in photorefractive processes was not satisfactorily explained up to now. Since PL intensity is sensitive to the photoinduced changes in the content of luminescence active defects and energy levels of the same defects may influence photorefractive properties and photoconductivity of Sn<sub>2</sub>P<sub>2</sub>S<sub>6</sub> crystals, the dependence of PL intensity on exposure time was studied on four Sn<sub>2</sub>P<sub>2</sub>S<sub>6</sub> crystals as a function of temperature (12 - 360 K) and illumination wavelength (300 - 800 nm).

All the Sn<sub>2</sub>P<sub>2</sub>S<sub>6</sub> crystals studied showed PL in the red and near-infrared spectral regions. Both PL spectral distribution and integral intensity were markedly sample-dependent under the same conditions. The variations with time of PL intensity were observed for all the crystals at temperatures lower than 170 K as a result of sample illumination with light with wavelength shorter than 710 nm at the same temperatures. The integral PL intensity of all the crystals cooled in the dark decreased at 12 K with time of steady-state excitation with monochromatic light with wavelength shorter than 510 nm. With respect to position of the absorption edge of the Sn<sub>2</sub>P<sub>2</sub>S<sub>6</sub> crystals near 496 nm at 10 K this finding indicates that PL excitation via the fundamental crystal lattice absorption decreases integral PL intensity of the crystals cooled in the dark. Likewise, the integral PL intensity of the orange tinted crystals cooled in the dark decreased at 12 K with time of steady-state excitation with monochromatic light with wavelength longer than 510 nm. On the contrary an increase of integral PL intensity was observed in the brown tinted crystal demonstrating opposite effect of illumination in the spectral region where PL of Sn<sub>2</sub>P<sub>2</sub>S<sub>6</sub> crystals is excited through absorption of crystal defects on the integral PL intensity of brown and orange tinted crystals. Heating of the crystal to suitable higher temperature partially or fully restored the initial PL intensity observed in the crystal cooled in the dark pointing to partial or full restoration of the initial content of corresponding luminescence active defects. The possible photoinduced changes of the charge state of supposable luminescence active defects in Sn<sub>2</sub>P<sub>2</sub>S<sub>6</sub> crystals resulting in the variations with time of PL intensity observed in the crystals illuminated in a suitable way at temperatures lower than 170 K are discussed.