NONLINEAR OPTICAL EFFECTS IN CRYSTALS OF LANGASITE FAMILY

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OVERVIEW

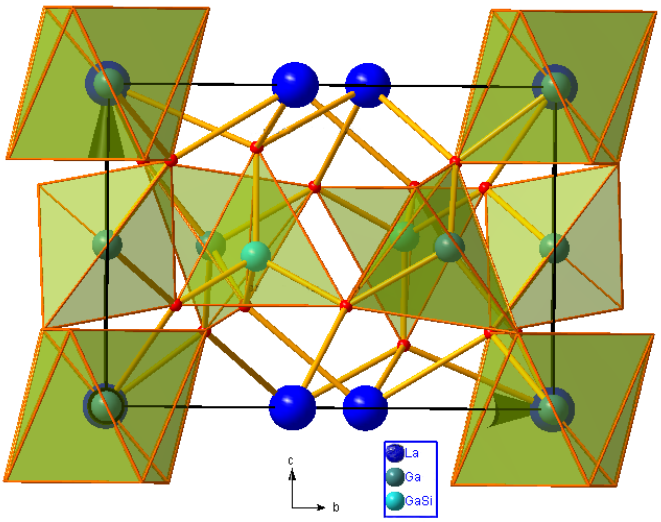
- **The structure of the crystals of langasite family**
- **DES model of calculation**
- **Calculations of SHG of the crystals of langasite family**

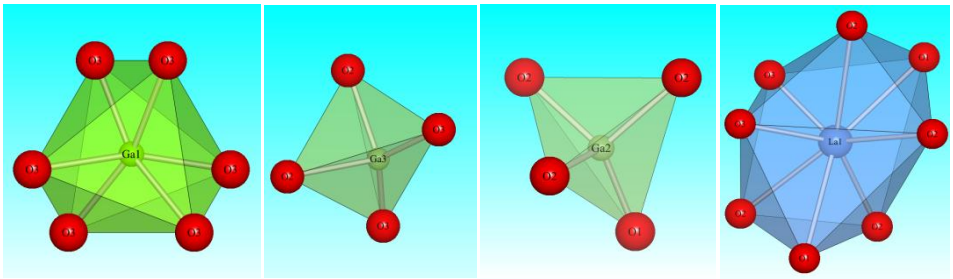
THE CRYSTALS OF LANGASITE FAMILY

Applications:

- **Optical properties of lanagasite family (Ca-gallogermanate structure type) crystals are interesting for numerous practical applications.**
- **These materials does not show any phase transition up to more than 1000 °C, which enables it to be used in the sensing technology at high temperature.**
- **At present, there are 140 compounds with a similar structure are known in this family.**

The Structure of the crystals of langasite family (Space group P321, Z = 1)





DES MODEL OF CALCULATION

DES – Dipole-Dipole Interaction Electron-Cloud Shifting Model.

Main equations of the DES [2, 3]

$$E^{loc.} = E^{external} + \frac{P}{3\varepsilon_0} = \frac{(\varepsilon + 2)}{3} E^{external}.$$

$$x_i(k) = \frac{4\pi\varepsilon_0}{e} \sum_j \alpha_{ij}(k) E_j^{loc.}.$$

$$x_i(k) = \frac{8\varepsilon_0}{e} \sum_j \alpha_{ij}(k) E_j^{light.}.$$

$$\varepsilon_{ij}\left(E_k^{ext.}\right) - \varepsilon_{ij}(0) = 2d_{ijk}E_k^{ext.},$$

$$a_{ij}\left(E_k^{ext.}\right) - a_{ij}(0) = r_{ijk}E_k^{ext.},$$

$$\rho_{ij}\left(E_k^{ext.}\right) - \rho_{ij}(0) = \frac{180}{n\lambda} g_{ijk}E_k^{ext.}$$

Where E^{loc}, E^{ext} denotes local and external electric field, ε the relative dielectric constant, a the polarization tensor, r and g the linear electro-optic and electrogiration tensors, d the second-order nonlinear susceptibility.

CALCULATION THE SHG COEFFICIENTS IN CRYSTALS OF LANGASITE FAMILY

$$\varepsilon_{ij}\left(E_k^{ext.}\right)-\varepsilon_{ij}\left(0\right)=2d_{ijk}E_k^{ext.}.$$

Crystal	d_{111}, pm/V	Experiment [1]
$Ca_3Ga_2Ge_4O_{14}$	0,8	0,9
$La_3Ga_5SiO_{14}$	1,5	1,7
$La_3Ga_{5.5}Nb_{0.5}O_{14}$	0,6	2,6
$La_3Ga_{5.5}Ta_{0.5}O_{14}$	1,3	2,3

CONCLUSIONS

- **DES method is successfully applied to crystals of langasit family.**
- **The second-order nonlinear optical susceptibility d_{111} tensor component is calculated for $Ca_3Ga_2Ge_4O_{14}$, $La_3Ga_5SiO_{14}$, $La_3Ga_{5.5}Nb_{0.5}O_{14}$, $La_3Ga_{5.5}Ta_{0.5}O_{14}$ crystals.**
- **A good agreement between observed and calculated values of the d_{111} coefficient is obtained for $Ca_3Ga_2Ge_4O_{14}$ and $La_3Ga_5SiO_{14}$ crystals.**

REFERENCES

[1] Haichao Lan, Fei Liang, Zheshuai Lin, et al. International Journal of Optics. 2017 (2017) 1-13.

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