☐ Oral Presentation ☒ Poster

OPTICAL DETECTION OF RADIATION-INDUCED DEFECT PHASE FORMATION IN SOLID XE

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Among various material processing techniques the radiation technology of crystal structure modification by low-energy irradiation is one of the most agile manufacturing method. Solid Xe is widely used as the model systems in fundamental investigations of electronically induced lattice modification and as the working media of particle detectors and positron moderators. The electronic excitations in solid Xe have been under investigation since seventies and now the overall picture of creation and trapping of electronic excitations is basically complete [1]. The spectroscopic properties of radiation-induced processes in solid Xe under synchrotron irradiation (at HASYLAB, DESY, Germany) were well studied recently [2]. In the present study we apply the kinetics methods for numerical simulation of defect processes in irradiated crystals and harness the rich luminescence spectra of solid Xe for real-time monitoring of their crystal structure.

Initial increase of the intensity of the 'defect' luminescence during irradiation reflects the accumulation of Frenkel pairs in the lattice as a result of exciton creation and self-trapping in the consecutive process $E + T \leftrightarrow MTE \rightarrow D$, where E is the mobile excitation (free exciton), which is trapped at trapping center T (lattice imperfection) and forms an excited metastable trapped center MTE [3]. The time dependence of 'defect' luminescence intensity under steady-state conditions is: $I(t) = I_0 + K \cdot t \cdot (L + t)^{-1}$, where $I_0 = I(0)$ is the initial intensity; K is the saturation value of $(I(t) - I_0)$ at $t \rightarrow \infty$; $L \sim n_E n_T (n_{MTE})^{-1}$ is a characteristic constant of a sample, n – concentration. At high defect concentration, n_D, the exciton self-trapping near existing defects induces the aggregation of defects in the process $MTE + D \rightarrow DD$. The time dependence in this case is $I(t) = K \cdot L' \cdot (L' + t)^{-1}$, where $L' \sim n_{MTE} n_D (n_{DD})^{-1}$. The best fit of our data for solid Xe results in values $K = 1668$ cps, $L = 43$ min, $L' = 814$ min.

[1] A.N. Ogurtsov, Advances in Spectroscopy of Subthreshold Inelastic Radiation-Induced Processes in Cryocrystals, In: Spectroscopy of Emerging Materials, Kluwer Academic Publishers (2004) 45.
[2] A.N. Ogurtsov, O.N. Bliznjuk, N.F. Kleshev, N.Yu. Masalitina, ITE 4 (2013) 24.
[3] A.N. Ogurtsov, N.Yu. Masalitina, O.N. Bliznjuk, Low Temp. Phys. 33 (2007) 591.