Project 4.9. Novel Composite Scintillation and thermoluminescent detectors based on epitaxial structures of orthosilicates and garnets.

Supervisor: Prof. Andrzej Suchocki

Institute: IFPAN

Unit: ON4.1

Webpage of group: http://info.ifpan.edu.pl/Dodatki/WordPress/on41pl/

Background:
Our proposals are related to the development of the new types of luminescent materials, based on the solid solutions of mixed orthosilicate and garnet compounds, prepared in the form of ***composite film-crystal epitaxial structures*** using Liquid Phase Epitaxy (LPE) growth method. We focus our attention on the development of scintillating and thermoluminescent (TL) materials, which can transform ionizing radiation in the visible or UV light. Apart from the scintillating and TL detectors, the fields of application of the compounds under study include also the cathodoluminescent screens, laser media, and photoluminescence converters for white LED, etc.
LPE method open the possibility of creating the composite scintillators of "phoswich-type" (phosphor sandwich) for registration of the different components of ionizing radiation, namely, for analysis of the content of mixed fluxes of particles and quanta with various penetrating depths. Such composite scintillators present the epitaxial crystalline structures, including one or two single crystalline films intended for registration of low penetrating α- and β-particles, and bulk single crystal substrates for registration of the high penetrating radiation (X- or γ-rays).

Aim:
In our project we will use the LPE method for development of the novel types of the 1) composite film-crystal scintillators based on the solid solution of Ce^{3+} doped $Lu_{2-x}R_xSiO_5$ (R=Gd, Y; x=0÷2) orthosilicates and $Lu_{3-x}R_xAl_{5-y}Ga_yO_{12}$ (R= Gd, Tb, Y; x=0÷3; y=0÷5) garnets; 2) composite film-crystal scintillating screens based on the solid solution of Ce^{3+}, Tb^{3+} and Eu^{3+} doped $Lu_{2-x}Gd_xSiO_5$ (x=0÷2; y=0÷1) orthosilicates and $Lu_{3-x}R_xAl_{5-y}Ga_yO_{12}$ (R= Gd, Tb; x=0÷3; y=0÷5) garnets; 3) composite thermoluminescent detectors based on the Ce^{3+}, Tb^{3+}, Eu^{3+} and Mn^{2+} doped LuR_xSiO_5 (R=Y, Gd; x=0÷2) orthosilicates and $Lu_{3-x}R_xAl_{5-y}Ga_yO_{12}$ garnets (R= Gd, Tb, Y; x=0÷3; y=0÷5).
The combination of the cation content in the mentioned mixed orthosilicate and garnet compounds opens also the possibility of creation of the wide sets of composite-film scintillators and TL detectors with different absorption ability of α- and β-particles and X- and ɣ-rays. This is necessary for the various kinds of applications of such scintillators and TL detectors for environmental radiation monitoring and security scanners as well as the 2D/3D imaging in microtomography, nondestructive testing in industry, biology, medicine, paleontology, etc.
Important part of the project will be related to high-pressure spectroscopy in diamond anvil cells (DAC). We do plan collaboration with several groups from abroad, including EU, China and others.

Requirements:
- Some experience in optical spectroscopy;
- M. Sc. in physics or chemistry;
- Experience in using spectroscopic equipment; programing skills (LabView, etc.)
- sufficient proficiency in English;

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