

Scintillation Crystals for Different Engineering Applications

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Introduction

Scientific-technological concern «Institute for Single Crystals» of Ukrainian Academy of Sciences (Kharkov) was established in 1955. It is concerned with development and production of new materials with specified properties for scintillation, laser, electronics, optical instrument-making industry.

The concern comprises a plant and a number of experimental production facilities for developing the technologies, created within the concern, and production output of materials and goods.

The main research and development activities of the concern are as follows:

1. Alkali-halide single crystals and polycrystals for scintillation equipment. Automated technologies for growing large alkali-halide crystals.
2. Oxide and chalcogenide scintillation single crystals. Scintillation electronic detectors and radiation control and microscopy devices.
3. New types of inorganic scintillation materials and glasses.
4. Organic scintillation crystals. Plastic and liquid scintillators. Radiospectroscopy of organic condensed media.
5. Oxide refractory single crystals for laser engineering, microelectronics, medicine.
6. Oxide ferro- and piezoelectric materials, functional ceramics.
7. Small film structures and liquid crystals for nanoelectronics, optoelectronics and sensor equipment. Condensed films of organic luminophores for light-diodes.
8. Multipurpose organic luminophores and dyes.

The priority class materials developed and produced by ISC is scintillation materials and detectors of different applications. I would remind you that scintillation detectors are used for detection and spectrometry of ionizing radiation - α , β , γ and x-ray radiation, heat and fast neutrons, short-range nuclear particles, high energy particles and other elementary particles of the matter.

The scheme presents the main development stages of these activities.

Halogen alkali metals (HAM) crystals are especially widely used.

The given diagram shows that they are applied in medicine, high energy physics, industry (units and elements defectoscopy), geophysics, environment control, protection systems. The next figure presents the increase in sizes and mass of our HAM single crystals year after year.

Presently, we produce practically all range of scintillation detectors based on HAM crystals of different shapes and sizes (including individual orders). The photo shows some of these detectors.

The basis for the produced detectors is new scintillation materials proposed by our scientists: cesium iodide doped with sodium CsI(Na), cesium iodide doped with carbonate-ions CsI(CO₃); undoped cesium iodide CsI; lithium fluoride doped with tungsten LiF(W) and others.

An original high-productive technology for growth and subsequent treatment of HAM single crystals was created in the ISC. This technology allows to obtain the crystals of uniquely large sizes (diameter more than 500mm) and mass (over 500 kg). One of such production-type large crystals is shown in the photo.

The characteristic feature of our technology is the high level of automated crystal growth process. It allows to reproduce the crystals of high structural performance with the specified distribution of activating dopants.

Side by side with HAM large single crystals growth, we developed the technology for manufacturing polycrystals, over 700mm in diameter, by means of plastic deformation of single crystals at high temperature.

The toxic elements, polluting the environment, such as thallium, cesium, iodine, are used in big amounts for HAM crystals production. However, we succeeded in creating the technology of closed circle which exclude the penetration of toxic agents into the environment. The created technologies are without wastes.

The presently available facilities allow us to produce up to 20 metric tons of HAM crystals per year; if necessary, these facilities can be doubled. The photo shows a part of production shop, where such crystals are produced.

The developed technology and created production facilities allowed the ISC, owing to the high quality and relatively low cost of the products, to participate in a number of big international projects in high energy physics, e.g.:

- supercolliders creation in Japan (Belle), USA (BaBar) and Switzerland (CERN, LHC project);
- participation in CDF collaboration for carrying out the experiments on the biggest in the world FNAL tevatron (USA);
- participation in astrophysical projects GLAST (in collaboration with Naval Research Laboratory, USA);

- collider creation in Switzerland (Pi-BETA, P-S Institute).

The limited license for scintillation crystals production by our technology was sold to «Siemens Medical Systems, Inc.».

Our detectors are used for equipping tomographic gamma-cameras and other medical equipment produced by a number of well-known companies in the world.

Our cooperation with foreign companies is carried out through Ukrainian-American company «Amcrys-H, Ltd.» which is a part of the concern.

Our proposals

The technologies and production facilities created by us can be used for advancing scintillation detectors and materials to the new markets of different world regions. Therefore, it is necessary to develop a dealer network in different countries and regions, including Asia, Africa and Latin America.

We are proposing to find the partners in the USA in order to establish effectively working dealer network. To establish such network, we will need several millions of dollars which will be repaid rather soon after the network starts to function.

We see our partnership as follows. We produce scintillation crystals and detectors on their base - our American partners provide their sales via the dealer network created by them. However, one should note that our crystals can be successfully used in medical and other equipment produced by US companies and other developed countries.

Conclusion.

The cooperation we propose looks very promising because of swiftly growing application of scintillation detectors in different fields of the modern engineering, especially in medicine. We hope that taking into the high quality, unique sizes and cost of our products, our proposals will raise an interest of American partners and considerably expand the spheres of our cooperation.