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CHRONICLE

International Conference on Inorganic Scintillators and Their Industrial Applications, SCINT 2005: Current Trends in Scintillator Materials Research

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The VIII International Conference on Inorganic Scintillators and Their Industrial Applications, held in Alushta on September 19–23, 2005, was organized by the Institute of Scintillating Materials (Kharkov, Ukraine) with the assistance of the National Academy of Sciences of Ukraine, the Institute of Single Crystals (Kharkov, Ukraine), Joint Institute for Nuclear Research (Dubna, Russia), and the Russian Science and Technology Center in Ukraine.

The conference began with the invited review lectures by A.N. Vasil'ev (Faculty of Physics, Moscow State University, Russia) and R.T. Williams (Wake Forest University, Winston-Salem, NC USA). Vasil'ev presented a theoretical analysis of various elementary processes underlying scintillation, and Williams addressed issues pertaining to increased radiative rates due to spatial coherence effects in systems of closely spaced emission centers, as observed in photonic crystals.

The technical program of the conference was divided into several symposia and technical sessions. Projects supported by NATO were the subject of a separate seminar.

The most attention at the conference was paid to medical imaging issues pertaining to state-of-the-art computed tomography with the use of hard x-ray sources or positron beams. These issues were addressed at different sessions, including the one devoted to nuclear medicine research. The invited reports by P. Lecoq (CERN, Switzerland) and R. Deych and E. Dolazza (Analogic Corp., USA) highlighted the enormous advances in tomographic imaging in the past decade. The emergence of novel tomographic imaging methods and effective scintillating materials made it possible to markedly enhance the imaging resolution and reduce manyfold the in vivo scan time, thereby reducing the hazard of radiation exposure. As pointed out by Lecoq, the latest achievement in positron emission tomography is the use of $LuAlO_3$:Ce detectors.

Note that doping with Ce^{3+} ions produces centers that emit light with a sufficiently high quantum yield and possess a short radiative lifetime. Ce^{3+}-doped scintillators (based on YAG, Lu(Y)–Si–O, Lu(Y)AlO_3, $Li_6Gd(BO_3)_3$, various halides, and other crystals) offer by far the best combination of brightness and response time for computed tomography. They were, quite deservedly, the subject of a whole session. As pointed out by C.W.E. van Eijk (Delft University of Technology, the Netherlands), the recently proposed scintillating materials $LaCl_3$:Ce and $LaBr_3$:Ce offer, along with the above advantages, an unprecedented energy resolution, and the quantum yield of LuI_3:Ce is as high as 9×10^4 photons/MeV. Many contributions dealing with cerium-doped scintillating materials were presented at the poster sessions.

One symposium focused on $PbWO_4$. Its great importance as a scintillator is due to its uniquely fast response, which makes it an attractive material for particle detectors in high-energy physics. Contributors from various countries discussed both the fundamental aspects of scintillation in this material and its potential commercial applications.

A large number of oral presentations and posters were centered on CsI-based scintillators. CsI:Tl was reported to have a very high emission efficiency, approaching the theoretically predicted level. One drawback to this material is, however, its persistent afterglow. As pointed out in a number of papers, this problem can be solved to some extent by introducing europium along with thallium. Studies of the afterglow mechanism in CsI:Tl,Eu, e.g., the one by L.A. Kappers et al. (USA), indicate that Eu^{2+} scavenges the electrons from shallow traps associated with thallium, thus suppressing afterglow in the time domain of tens of milliseconds, but enhancing afterglow in the longer time domain of seconds and minutes.

Several papers were presented at the session devoted to nanomaterials. The size of scintillator nanoparticles was reported to influence both the luminescence brightness and the radiative time, which offers the possibility of tuning these parameters by varying the particle size. In connection with this, an interesting question was posed in the report by Yu. Malyukin (Institute of Single Crystals, Kharkov, Ukraine): How does an activator ion whose electrons are well localized sense the crystal size? This question can be answered, according to Malyukin, by taking into account the electron–phonon interaction, the quantum size effect in the band structure of the crystal, and the effect of the crystal boundaries on the electromagnetic field.

Several sessions comprising the New Scintillation Materials Symposium discussed the search for new neutron detector materials and the potentialities of Pr^{3+}-doped materials, which might in the foreseeable future be competitive with Ce^{3+}-doped scintillators. According to P. Dorenbos (Delft University of Technology, the Netherlands), the new scintillating material PbI_2, which has not yet been studied in sufficient detail but is known to offer a quantum yield of 2×10^5 photons/MeV and radiative time of 1 ns, may supersede well-known compounds with cross luminescence, such as $PbWO_4$ and BaF_2.

A potentially attractive approach to producing new luminescent materials, offering a unique possibility of controlling the direction of light propagation and the lifetime of excited states, is the creation of emission centers in photonic crystals—optical media with periodic modulation of their refractive index on a length scale close to the emission wavelength. This issue was addressed in the report by Klimonskii et al. (Faculty of Materials Science, Moscow State University), who presented experimental data on the spatial redistribution of light intensity emitted by a photonic crystal containing Eu^{3+} activator centers.

The Organizing Committee decided that, at the next conference, which will take place in two years in Winston-Salem, this issue should be the subject of a separate symposium.