OPTIMIZED MATERIALS FOR EFFICIENT RADIATION PROTECTION

A significant contribution to scientific progress in the last century has arisen from the discovery of radiation, which is produced by nuclear reactors, particle accelerators, radioactive materials and conventional x-ray sources. Scientists, engineers and technicians who work in these fields require radiation dosimeters to monitor any undesired exposure to radiation. Investigating the use of new materials in these dosimeters is required in order to find more sensitive and efficient materials.

LUMINESCENT DOSIMETERS

The Estonian dosimeter company Lumifor OÜ is developing new dosimeters containing the luminescent material $Li_2B_4O_7$:Mn, but further measurements were needed to fully understand the electronic processes that take place during the radiation detection.

The function of the dosimeter is based on the process of Thermoluminescence (TL), during which a previously irradiated material is heated to a high temperature and the emitted visible light is proportional in intensity to the absorbed radiation dose. The electronic mechanisms responsible for this phenomenon can be rather complicated and to optimize the material's performance as a dosimeter, spectral analysis on the emission and excitation properties of their visible luminescence is necessary.

MEASURING EXCITATION AND EMISSION SPECTRA

A study within the Science Link project enabled the investigation of samples of $Li_2B_4O_7$:Mn using synchrotron vacuum ultraviolet (VUV) radiation at DESY in Hamburg, and typical excitation and emission spectra are shown in Figure 1. Two very different emission peaks were observed which have been attributed to dopant Mn ions and to self-trapped excitons (STEs) which arise from the $Li_2B_4O_7$ matrix itself, as indicated in Figure 1. The origin of each luminescence peak is proven by analysis of the excitation spectra. Excitation spectra at such high energies are not possible with standard laboratory spectrometers. The emission spectra could be compared to that observed during the TL process, and all TL peaks could be shown to arise from luminescent Mn dopant ions. This understanding of the electronic processes involved in the luminescence mechanism in $Li_2B_4O_7$:Mn dosimeter materials, has enabled Lumifor to continue developing and optimizing their products.

Figure NUMBER ONE

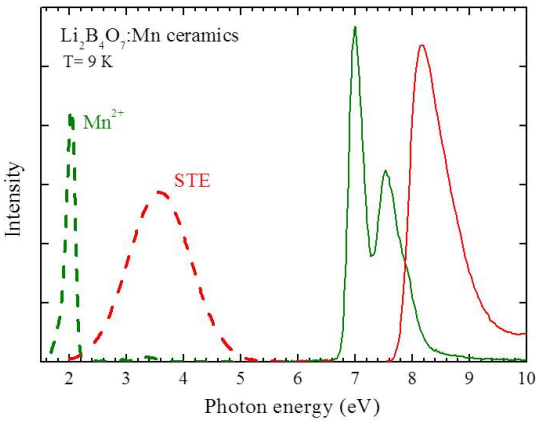

Figure 1 VUV excitation (solid lines) and emission spectra (dashed lines) of $Li_2B_4O_7$:Mn ceramic materials measured at 9K at DESY.

Science Link is a network between leading research facilities of photon and neutron sources and its users. The project aims to support and encourage innovation and entrepreneurship in the Baltic Sea Region. Apart from the research facilities, the network also includes scientific institutes, universities and regional organisations that serve as service and promoting units. Science Link is part-financed by the European Union (Baltic Sea Region Programme) and involves 17 partners from 8 countries during the project period 2012 to 2014.

For further information visit science-link.eu

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Research facilities

DESY
HZB Helmholtz Zentrum Berlin
Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research
MAX IV LABORATORY