Wigner 121
Scientific Symposium

Wigner Research Centre for Physics
Institute for Particle and Nuclear Physics
Materials Science by Nuclear Methods
Ion Beam Physics Research Group

Introduction

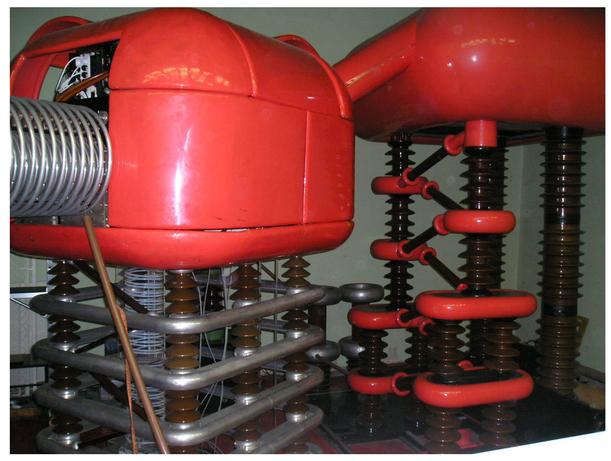
The Ion Beam Physics Group is dedicated to the ion beam modification and analysis of solid surfaces. Its activities include research in biology, environmental and materials science, archeology and cultural heritage. Ion beam analysis (IBA) is an important family of modern analytical techniques involving the use of MeV ion beams to probe the composition and obtain elemental depth profiles in the near-surface layer of solids.

The research group oversees two accelerators of Wigner RCP that belong to the Functional Materials Laboratory (FunMatLab) recognized as an Excellent Research Infrastructure by the National Research and Innovation Office.

Beside backscattering spectrometry (BS), elastic recoil detection analysis (ERDA), particle-induced X-ray emission (PIXE), and nuclear reaction analysis (NRA) the ionoluminescence (IL) technique was implemented in the last years.

Research Infrastructures

Van de Graaff accelerator

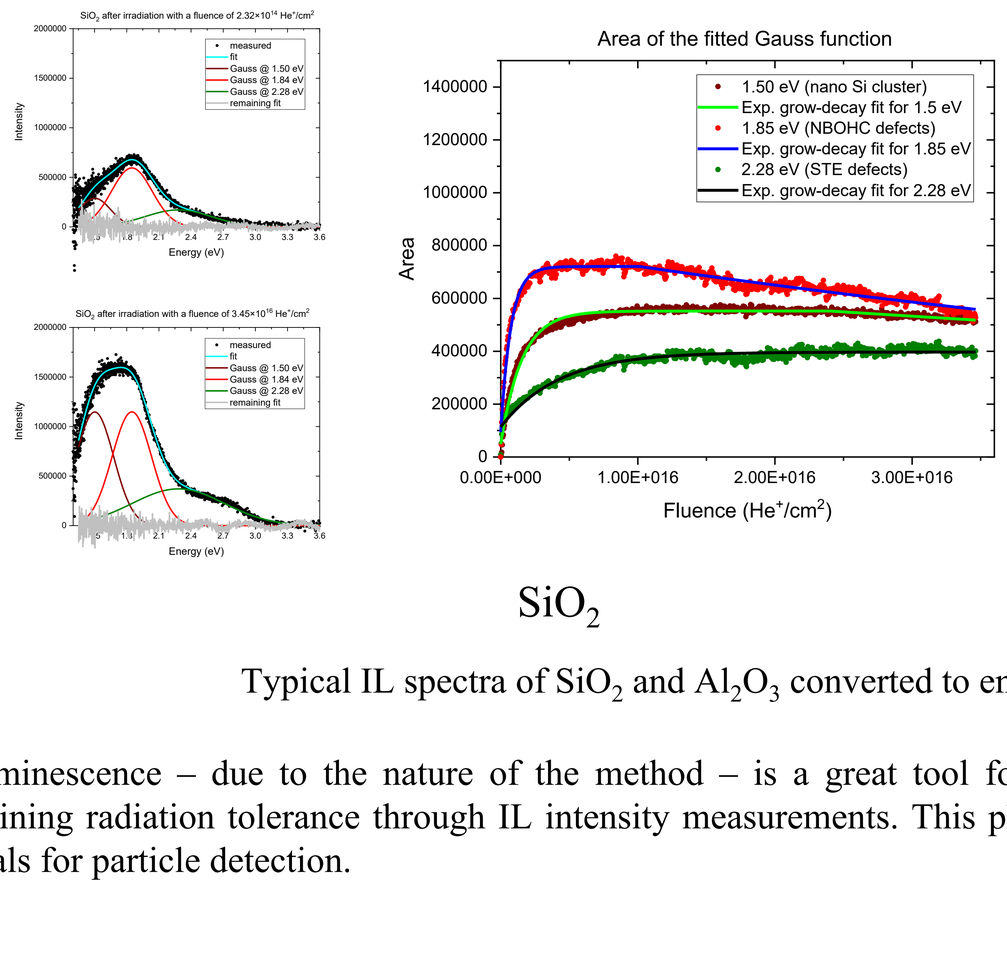


Heavy-ion cascade generator

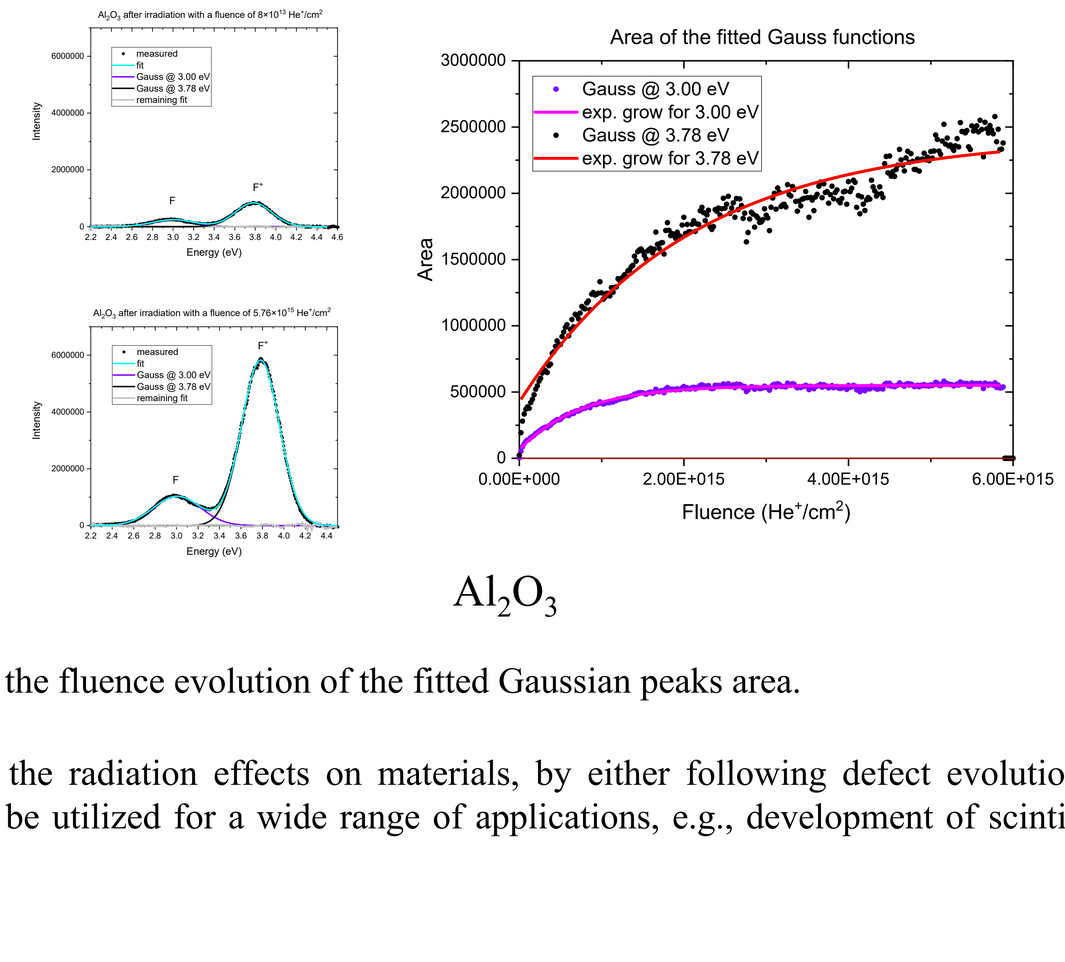
Method

In case of IL the emitted light induced by the incident ion beam is detected in the wavelength range of 200-1000 nm. This technique, as all other luminescence methods (photo-, electro-, etc.), is a very sensitive probe for identifying impurities and structural changes in insulators and semiconductors. However, all ion beam experiments can be considered as ion implantation; defects will be produced during the measurements. Accordingly, repeating the IL measurements successively on the same spot, the IL intensity as a function of fluence can be determined.

Results



SiO_2



Al_2O_3

Typical IL spectra of SiO_2 and Al_2O_3 converted to energy scale and the fluence evolution of the fitted Gaussian peaks area.

Ionoluminescence – due to the nature of the method – is a great tool for determining the radiation effects on materials, by either following defect evolutions or determining radiation tolerance through IL intensity measurements. This phenomena can be utilized for a wide range of applications, e.g., development of scintillator materials for particle detection.

Related publications

[1] *Fluence evolution of defect-related optical centers in SiO_2 determined by ionoluminescence*, E. Szilágyi, M.K. Pal, E. Kótai, Z. Zolnai and I. Bányász. It will be presented at IBA & PIXE 2023, (7 - 13 October 2023 - Toyama, Japan).

[2] *Helium ion beam induced luminescence of Al_2O_3 for charged particle detection*, Z. Zolnai, E. Szilágyi, M. K. Pal, and E. Kótai. It will be presented at IBA & PIXE 2023, (7 - 13 October 2023 - Toyama, Japan).

Hungarian Research Network

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