The structural properties anisotropy of β-Ga_2O_3 implanted with Yb

Renata Ratajczak[1], Mahwish Sarwar[2], Cyprian Mieszczynski[1], Przemysław Jozwik[1], Wojciech Wozniak[2], Ulrich Kentsch[3], René Heller[3] and Elzbieta Guziewicz[2].

[1] *National Centre for Nuclear Research, ul. Soltana 7, 05-400 Otwock, Poland*
[2]*Inst. of Physics, Polish Acad. of Sciences, Aleja Lotnikow 32/46, PL-02668 Warsaw, Poland*
[3]*Helmholtz-Zentrum Dresden-Rossendorf, Bautzner Landstrasse 400*
D-01328 Dresden, Germany
*presenting author, e-mail: Renata.Ratajczak@ncbj.gov.pl

Nowadays doped and un-doped gallium oxide is one of the most exciting materials in research and technology, and one of the most important tasks in this issue is the development of controlled methods of doping this material. Rare earth-doped Ga_2O_3 seems to be attractive for future optoelectronic devices such as phosphors, displays, and LEDs with emission in the visible spectral range. The ion implantation technique is one of the attractive ways to produce such systems. However, even though ion implantation is the most common semiconductor doping method, the studies of this process for Ga_2O_3 with RE are still at the initial stage.

In our recent research, we paid particular attention to the issue of the Ga_2O_3 anisotropy (in its thermodynamically stable β-Ga_2O_3 phase), which has not been theoretically predicted, but experimentally observed in optical and electrical investigations. In this work, the studies on the structural properties of β-Ga_2O_3 crystals, (010) and (-201) oriented, irradiated with different fluencies of Yb ions and subsequently annealed, have been performed. The crystal lattice damage, structure recovery, as well as Yb depth profiles, and Yb ions location in the β-Ga_2O_3 crystal lattice, were studied by Rutherford Backscattering Spectrometry in the channeling direction (RBS/c) and supported by computer simulations. Our studies reveal the strong influence of anisotropy on structural properties, with a significantly lower damage level for (010) oriented β-Ga_2O_3 crystals, and a small number of substitutions of gallium sites by Yb atoms as well. Interestingly, contrary to the common opinion, ~~is~~ that the β-Ga_2O_3 has strong radiation resistance, our results show that it is very easy to make this material amorphous. However, the crystal lattice recovery is also much easier than in other wide bandgap materials.

Acknowledgments *The work was supported by the NCN project UMO-2022/45/B/ST5/02810 and RADIATE projects 21002661-ST, 21002663-ST realized at IBC, Helmholtz Zentrum Dresden Rossendorf.*