Post-implantation Defect Accumulation in Crystal Lattice of β-Ga_2O_3 Implanted with Yb ion

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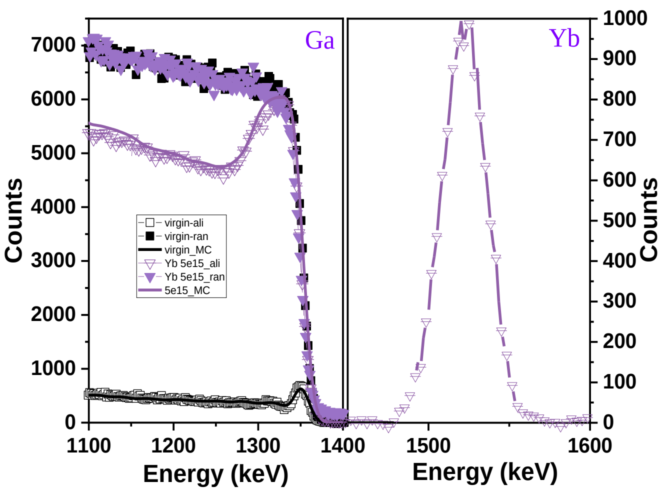
Gallium oxide (Ga_2O_3) is an ultra-wide bandgap semiconductor of interest for many applications, including optoelectronics. Undoped Ga_2O_3 emits light in the UV range, that can be tuned to the visible region of the spectrum by rare earth dopants. Ytterbium may further enhance the span of applications due to emission in the infrared region of the spectrum. Ion implantation is a renowned doping technology used for the alteration of material properties. Despite of many advantages of this technique, it could lead to lattice damage and defect accumulation which need to be studied thoroughly as these factors strongly influence the material properties.

Our previous work, where we studied structural defects and recovery of the crystal lattice of β-Ga_2O_3 after Sm implantation and post-implantation annealing, indicates that the damage of the crystal lattice after implantation is not typical and needs further investigations [1]. In the present study, the (-201) orientated β-Ga_2O_3 single crystals were implanted with Yb ions fluences ranging from $5x10^{11}$ to $5x10^{15}$ at./cm^2. Channeling Rutherford backscattering spectrometry (RBS/c) was used to study modification of the crystal lattice induced by ion implantation and annealing. The RE depth profile was analyzed by the SIMNRA calculations, while the McChasy simulations were used to quantify the defect distributions. The obtained accumulation curve reveals the two-step damage process. From the fluence of $5x10^{13}$ /cm^2, the damage of the Ga_2O_3 lattice starts to increase very fast, reaching the amorphization level for the Yb ion fluence of $1x10^{14}$ /cm^2. The new form of defect that is created on the highest level is found to be annealing resistant.



Random and aligned RBS/c spectra for β-Ga_2O_3 implanted with Yb. The solid line represents the McChasy simulations.

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References

[1] M. Sarwar et al., *Adv. in Sci. and Tech. Research Journal* 2022, 16(5), 147–154