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Can we dope the wide gap Ga2O3 semiconductor? - ion implantation and hyperfine interactions studies

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The interest and study of nanomaterials has grown considerably in recent years due to promising applications in everyday's life technologies. With its relevance depending on tunable properties working at large-scale integration devices, a new battlefield is created since; small scale rules both new properties and new problems. By merging nanostructures with thin film technologies advantageous manufacture is expected where, particularly, ion implantation is investigated as a standard part of the tuning processes. But, ion implantation carries along with the benefits –universal dopant and profile tuning –intrinsic nuisances, i.e., defects created within such poor solubility compounds. A nanoscope tool is necessary, and nuclear hyperfine techniques can provide, at the appropriate scale, an inside view of these problems. When using radioactive elements, produced on-line at ISOLDE-CERN, the number of elements is extended, in particularly with the use of the Perturbed Angular Correlations (γ-γ PAC) technique, to characterize the probe's real environment at the atomic scale.
Moreover, it is also possible to use the e-γ PAC technique - which allows inducing an electronic excitation upon the conversion electron ejection from an atomic orbital - to study the dynamics of the electronic response in the atom neighboring as a function of temperature and time, ranging from the nano to the micro - second time scale. The response depends on the availability of charge carriers and on the intrinsic relationship impurity/dopant- host.
Finally, the experimental results are compared to DFT simulations of different atomic local models and charge configurations.
In the present work, the use of such techniques to study nanostructures of the wide band gap semiconductor Ga2O3 will be demonstrated.

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