Contribution ID: **31** Type: **Poster**

Electronic dynamics and probe location in Ga2O3

Transparent conductive oxides (TCOs) are widely studied today because of being electrically conductive while being optically transparent, which make them quite desirable for technological applications.
Among the TCOs family, gallium oxide (Ga2O3) has the widest band-gap, 4.8 eV, making it interesting for photonic applications working in the visible and UV wavelength region. Ga2O3 is an intrinsic n-type semiconductor, therefore the scientific community is actively searching for p-type doping candidates, such as Cd.
By measuring the local charge distribution the Perturbed Angular Correlation (PAC) technique allows the determination of the probes'atomic location and the impurity/dopant-host interactions. Additionally, being a time differential method, it can map the recombination of ionized and excited electronic states of the impurity/dopant in the material under study.
In the present work, we used such techniques to study nanostructures and powder pellets of Ga2O3 after implantation and diffusion of 111In/111Cd and 111mCd/111Cd where the location of Cd probes was identified.
Then by combining γ−γ PAC with 111In, 111mCd and the e-γ PAC technique with 111mCd, we found the existence of long lived excited states at the Cd acceptor and, as well, a correlation of the electronic recombination after the 111In electron-capture decay with the carrier density and electron mobility in the material, as a function of temperature.
To validate the interpretation of the experimental results, today there are available powerful Density Functional, DFT, simulation methods via the implementation of different atomic local models and charge configurations, producing hyperfine parameters to be compared with the experimental data obtained with the PAC technique.
In this work we will present the resume of data, analysis and perspectives of combining the γ−γ and e-γ PAC technique to study electronic dynamics onto semiconductors and insulator materials.

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