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# Characterization of GaN structures by a combined SIMS & HAXPES approach

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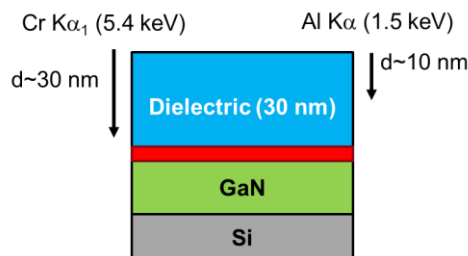
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Among III-N materials, GaN shows great promise and is already used in the electronic industry but there are still technological issues to resolve. Consequently, characterization techniques capable of providing information at the nanometer scale are required in order to meet the industrial demand of this market. The combined approach of hard x-ray photoelectron spectroscopy (HAXPES) and secondary ion mass spectrometry (SIMS) is an attractive method to analyse buried interfaces.

HAXPES is an efficient method to probe buried interfaces. The x-ray source used is Cr  $K\alpha_1$ , emitting at 5414.9 eV [1, 2]. In addition, HAXPES instrument is useful for GaN study to solve Auger interferences on N1s peaks and hence, to get a better determination of the N/Ga stoichiometry. On the other hand, dynamic magnetic sector SIMS at low impact energy (250 eV- 500 eV) is a powerful instrument to depth profile structures with an excellent depth resolution and to detect impurities and dopants such as B ,C, O, H etc. with a higher sensibility than HAXPES.

Here, we study a dielectric/etched GaN structure by SIMS and HAXPES, focusing on the Ga chemical environment and depth profiling of impurities such as Cl, B, C, O, H etc. at the dielectric/GaN interface. The dielectric/etched GaN interface properties are critical for the formation of the metal-oxyde-semiconductor (MOS) channel in GaN high electron mobility transistors (MOSc-HEMT). In particular, we studied the gallium oxide thin layer (few nm) (Fig 1), which leads to charges, that affect the threshold voltage of MOSc-HEMT [3]. We observed that plasma etching [4] of GaN as well as dielectric deposition impact on the impurities presence at the dielectric/GaN interface and on the gallium oxidation.



*Figure 1: Schematic representation of a MOSHEMT structure with a comparison of depth probing between Cr  $K\alpha$  and Al  $K\alpha$  x-ray sources*

## References:

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[3] L.Vauche et.al, ACS Applied Electronic Materials 2021 3(3), 1170-1177

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