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# Study of $\text{In}_{0.53}\text{Ga}_{0.47}\text{As}/\text{InP}/\text{InAlAs}/\text{InP}$ heterostructures by TOF-SIMS and HAXPES

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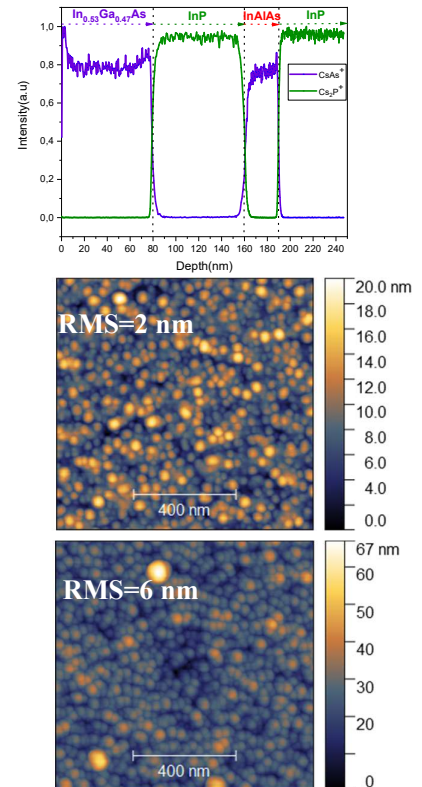
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## Abstract

The advantages of III-V semiconductors such as their direct gap and high charge carrier mobility make them interesting for optoelectronics applications, high-frequency transistors (HBTs) and high electron mobility transistors (HEMTs) [1]. Although the growth of heterostructures such as  $\text{In}_{0.53}\text{Ga}_{0.47}\text{As}$  on InP has a tuned lattice parameter, interdiffusion of the main elements and dopants can reduce device performance. Time-of-flight secondary ion mass spectrometry (TOF-SIMS) has proved ideal for studying buried interfaces [2]. For III-V semiconductors, the choice of abrasion gun and analyzer polarity is a key factor in achieving good ionization efficiency of the elements to be monitored [3]. For such materials, for example, it has been shown that using a dioxygen gun ( $\text{O}_2^+$ ) for sputtering results in depth resolution degradation due to the formation of an oxide layer at the bottom of the crater [4].

In this presentation, we'll show how the use of two analyzer polarities and the choice of abrasion and analysis guns ( $\text{Cs}^+$  and  $\text{Bi}_3^+$ ) enable complete monitoring of the main elements, dopants and impurities in heterostructures such as  $\text{In}_{0.53}\text{Ga}_{0.47}\text{As}/\text{InP}/\text{InAlAs}/\text{InP}$ . We'll compare TOF-SIMS analyses using  $\text{Cs}^+$  and  $\text{O}_2^+$  sputtering sources. From AFM images of the crater formed, we obtain roughness values around 2 and 6 nm using the  $\text{Cs}^+$  and  $\text{O}_2^+$  sources respectively. This difference is due to the formation of an oxide layer at the bottom of the crater in the case of the  $\text{O}_2^+$  source, which destroys depth resolution. High-energy photoelectron spectroscopy (HAXPES) with a chromium source Cr  $K\alpha$  ( $h\nu=5415$  eV) [5] will be used to quantify the elemental composition and investigate chemical environments at the buried InGaAs/InP interface, showing for instance the absence of interfacial oxidation.



**Figure 1:** TOF-SIMS profiles and AFM images of the crater formed for  $\text{Cs}^+$  and  $\text{O}_2^+$  abrasion respectively for  $\text{In}_{0.53}\text{Ga}_{0.47}\text{As}/\text{InP}/\text{InAlAs}/\text{InP}$  heterostructures.

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