Spectroscopic ellipsometry, a powerful probe to assess the surface modifications of III-V layers after GD-OES plasma sputtering

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Interfaces are of primary importance in heterostructures. We propose here an innovative methodologic development to access the chemical information in depth and, more especially, at buried interfaces. This specific approach is based on the combination of Glow Discharge Optical Emission Spectroscopy (GD-OES) plasma profiling, enabling to quickly and precisely reach buried interfaces, with X-Ray Photoelectron Spectroscopy surface analyses, bringing an accurate determination of the composition and the chemical environments. The representativeness of the crater chemistry is therefore a critical issue. Thus, to ensure the reliability of the chemical information obtained by surface analyses inside the GD-OES crater, a preliminary evaluation of the possible surface perturbation generated when stopping the plasma sputtering is mandatory. We will focus here on the optical modifications of III-V layer after GD-OES sputtering determined by spectroscopic ellipsometry (SE) and on the real added value and potentialities of SE to accurately detect chemical, morphological and microstructural evolutions of surfaces. The results obtained on InP [1], GaP and GaAs surfaces clearly evidence that the qualitative comparison of the SE response is sufficient to determine if a surface chemical modification has occurred. SE is indeed a very efficient technique to follow, by a non-destructive way and in reasonable acquisition time, the variations of the optical response in relation with variation of experimental conditions. Moreover, SE is easier to perform than systematic XPS characterization and offer, as for XPS, the possibility to perform mapping. SE is then a privileged tool to evaluate not only the perturbation but also the regeneration of the surface.

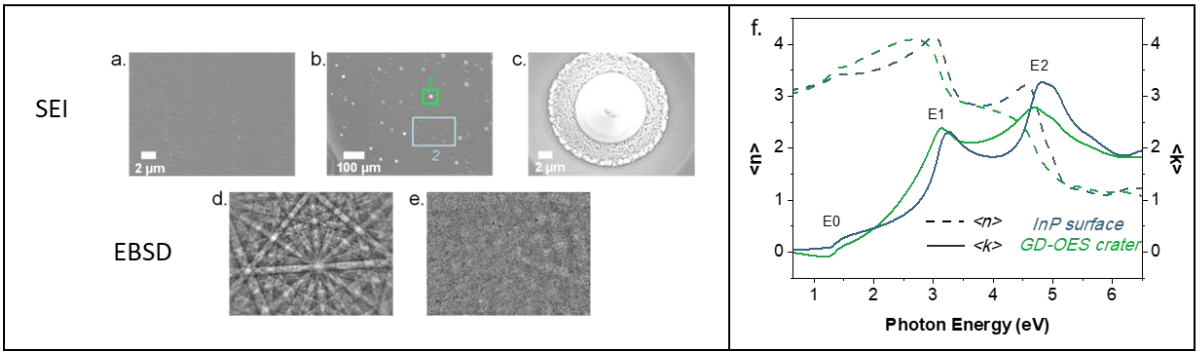

FIGURE. 1. Secondary electron images of an InP surface (a) outside and (b, c) inside the GD-OES crater, corresponding EBSD kikuchi patterns (d) outside and (e) inside the crater, (f) optical indexes (<n> and <k>) of InP deoxidized surface (blue) and GD-OES crater surfaces (green).

References

[1] S. Béchu, C. Eypert, A.Loubat, J. Vigneron, S. Gaiaschi, P. Chapon, M. Bouttemy, A.Etcheberry, "Evaluation of the chemical and optical perturbations induced by Ar plasma on InP surface", Journal of Vacuum Science and Technology B XXX (2019) accepted.