

## Characterisation by electrochemistry and chemical surface analysis of an oxide film on n-InP

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The control and/or the elimination of thin oxide on the surfaces of semiconductors are a relevant challenge for the quality and the performances of a lot of semiconductor technologies. The composition, the chemical stability, the nature of the electrical properties of the native or related native oxides/semiconductor interfaces are the principal parameters that will govern the behaviours of the devices for which such an interface is present.

The aim of this work is to show how electrochemical approach coupled with surface analyses (XPS and photoluminescence experiments) provides a qualitative and quantitative characterisation of an "oxide" growth and its properties. The anodic oxidation of n-InP is performed in a potentiostatic mode under illumination at pH9. Photocurrent transient responses, recorded under anodic control illumination time, coupled with surfaces analyses (XPS), give information on the thickness, on the chemical composition, on the stability, on the reproducibility and also on the passivation properties of the "oxide" film. A very fast growth and formation of a very thin and stable "oxidised" phase has been evidenced and the thickness of this is valued about a few monolayer equivalent [1]. The electrical and chemical blocking properties of the "oxide" film at fixed anodic polarisation have been demonstrated [2].

In this work, we focussed our attention on the electrochemical tools to investigate the electrical properties of this "oxide" at more anodic polarisation. Study of the photocurrent recorded after the n-InP oxidation at more anodic polarisation is an in situ probe of oxides electrical properties and gives more information about the growth state of this "oxide". There is not photocurrent on n-InP modified until anodic polarisation at  $V=+0.5\text{V/MSE}$  (fig. 1).

Capacitance measurements performed in the dark before and after the second photocurrent transient give more information on the interface semiconductor/electrolyte. The change of the potential drop across the interface is induced by the "oxide" film present onto n-InP. Flat Mott-Schottky representation (fig. 2) characterises a good passivating properties of the "oxide" after the first and the second photocurrent transients. Photoluminescence results confirm the electrically blocking "oxide" film at more anodic polarisation ( $V>-0.2\text{V/MSE}$ ) until  $V=+0.5\text{V/MSE}$  (fig. 3).

To conclude, the study of photocurrent transient recovery, capacitance measurements coupled with surface analyses (XPS, photoluminescence) show that the "oxide" film present onto n-InP induces change of the potential drop across the interface. The potential fall inside the "oxide" film leads to the decrease of the band bending. The photo-oxide is electrically blocked at more positive polarisation  $\Delta E = 0,7\text{V}$ .

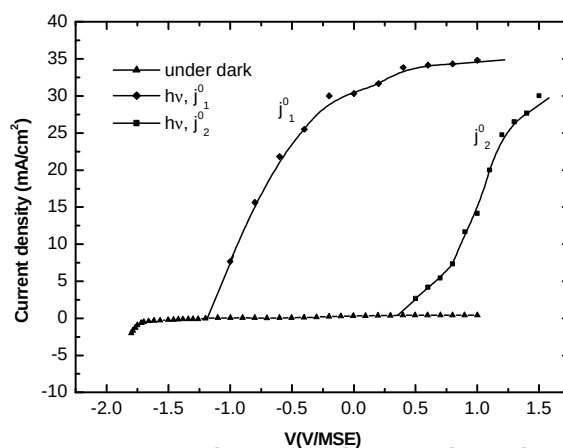


Fig.1: Instantaneous photocurrent density vs the anodic polarisation

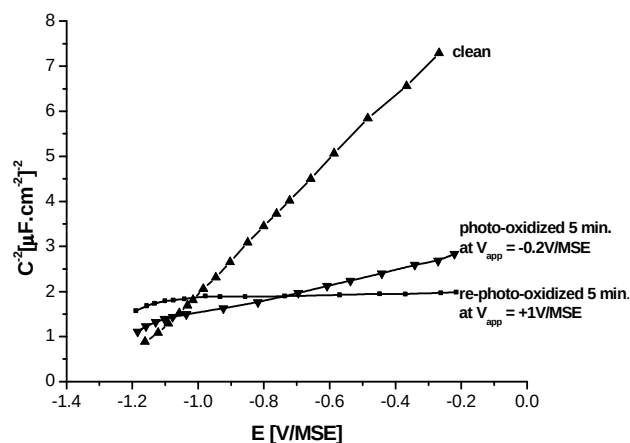


Fig.2: Mott - Schottky representation of n-InP; pH9  $f=1107\text{Hz}$ , in the dark

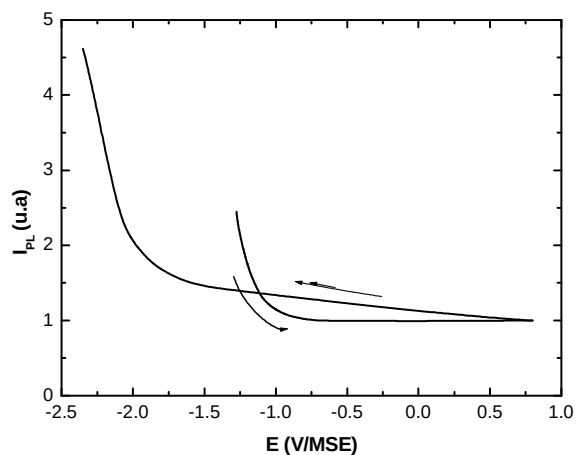


Fig.3: Normalised photoluminescence intensity of n-InP vs the polarisation after the photo-oxidation of the surface during 5 min.

[1] N.C Quach, I. Gérard, N.Simon and A. Etcheberry, *phys.stat.sol.*, (2002)

[2] N. Simon, I. Gérard, C. Mathieu and A. Etcheberry, *Electrochimica Acta*, 47, 2625-2631, (2002)