Growth of anodic oxides on InP studied by electrochemistry and surface analysis

Correlation between oxidation method, oxide texture and passivating properties

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Anodic oxides obtained on n-InP at pH9 under illumination and applied polarization have been studied in a previous work [1]. The growth of a thin (# few nm), homogeneous and stable mixed In-P oxide layer has been evidenced. Measurements of photocurrent transients and capacitance measurements exhibit important electrical blocking properties suggesting good passivating behaviors.

Study of photocurrent transients and capacitance measurements performed before and after the SC surface oxidation are in-situ probes of oxides electrical properties. Previous works [1-2] shown that, in our operating conditions, the presence of a photoresponse on n-InP (given by I^0_2/I^0_1: ratio of the photocurrent level on oxidized surface against level on non-oxidized surface) coupled with a quasi-parallel displacement of the Mott-Schottky representation, must be considered as the proof that the solution is directly in contact with the InP surface (via porosities). At the opposite, oxide layers with important passivating properties give small photocurrent recoveries associated to nearly flat MS representations.

XPS analysis give access to the chemical aspect, the ratio between the two phosphorus contributions P_{ox}/P_{InP} is relative to oxide coverage levels. Oxides composition is given by In_{ox}/P_{ox} ratio.

In the present work, the chemical and electrical properties of oxide layers performed under an applied current density configuration have been compared. The SC oxidation has been studied for current densities varying from 0.2 to 12 $mA.cm^{-2}$, by coupling the electrochemical approach (see fig.1) with XPS analysis (see table 1).

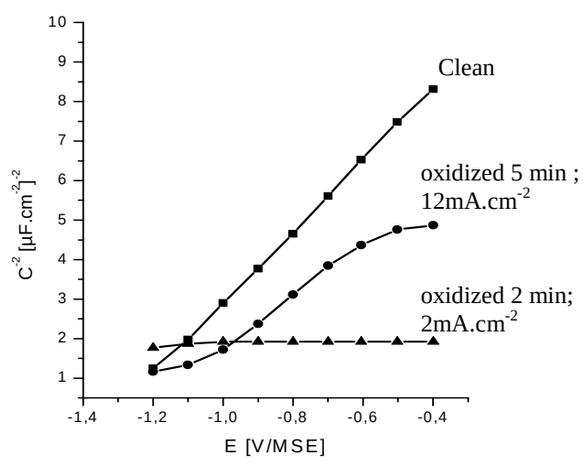

Fig. 1: Mott-schottky representation of n-InP; pH9; f = 1107Hz; in the dark

This work has evidenced an important correlation between the oxide growth method and the resulting chemical (composition, texture) and electrical properties. Table 1 compares the electrical and chemical properties of the following oxides.

Oxidation method	**Weak galvanostatic 0.2 $mA.cm^{-2}$;2 min**	**Strong galvanostatic 12 $mA.cm^{-2}$; 2 s**
Q_{ox} ($mC.cm^{-2}$)	24	24
I_0^2/I_0^1 (%)	0.3	10
P_{ox}/P_{InP}	1.4	7-10
In_{ox}/P_{ox}	1.7	3

To conclude, weak applied current density leads to the formation of thin (# few nm) and homogeneous oxide layers very similar to what is obtained with a potentiostatic mode. At the opposite, when the current density increases, thicker and less homogeneous oxides are prepared, presenting poor passivating properties.

[1] N. Simon, I. Gerard, C. Mathieu and A. Etcheberry, *Electrochemica Acta*, 47, 2625-2631, (2002)

[2] N. Simon, I. Gérard, J. Vigneron and A. Etcheberry, *Thin Film Solid*, 400, 134-138, 2001