Visible Photoluminescence from Anodized p-InP(100) in 1M HF

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In recent years, the localized dissolution of semiconductors has generated a great deal of renewed interest as a result of light emitting porous silicon and its large number of potential applications (see e.g., Refs. in [1-4]). Also for other semiconductor materials such as III-V compounds, research on localized dissolution has increased in the last few years (see e.g., Refs. in [3]).

The anodization of p-type semiconductors in acidic solutions, leads normally to electropolishing of the surface. It is well known only for p-type silicon that in HF containing solutions porosification takes place [5]. In this work it was found that by a potentiostatic anodic polarization of p-type InP in 1M HF instead of electropolishing a modification of the surface occurs. The surface exhibited blue, red and yellow colours. In the SEM images (Fig. 1a) a porous layer is obtained, which changes its structure (Fig. 1b) in the different coloured regions. Polarization experiments were done for different times and at different potentials. All curves showed a linear current density decrease. As a result of previous work on the porosification of n-type InP, where different pore morphologies appeared by using different halogenic acids [6], polarization was also carried out in HCl. Here, however, only electropolishing occured. Surface analyses of the HF-samples show that the different regions have also different compositions of indium- and phosphorus-oxides. The direction of growth of these oxides is from the air/electrolyte interface downwards to the edge of the immersed sample (Fig. 2). The spatial expansion and the growth rate are determined by the polarization time and the applied potential. By covering the air/ electrolyte interface with a varnish, no formation of coloured oxides on the surface appeared. This indicates, that the initiation process of the oxide formation really starts at the interface. PL measurements show a bright visible photoluminescence from these porous layers (Fig. 3).

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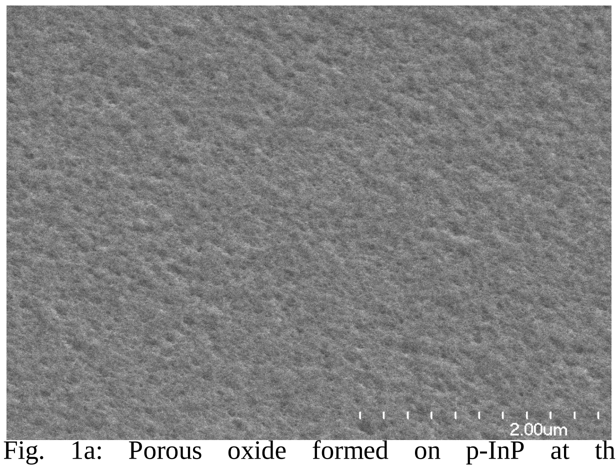

Fig. 1a: Porous oxide formed on p-InP at the air/electrolyte interface in 1M HF after polarization at 3000mV for 180s

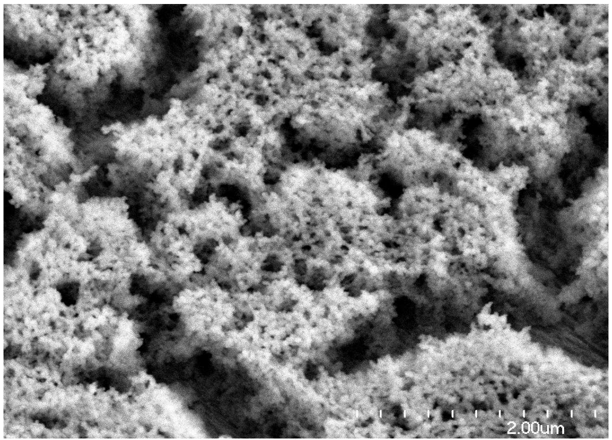

Fig. 1b: Porous oxide formed on p-InP below the air/electrolyte interface in 1M HF after polarization at 3000mV for 180s

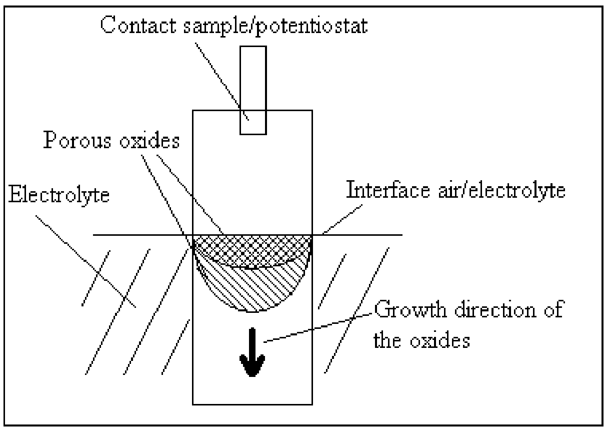

Fig. 2: Schematic drawing of the immersed sample and the growth direction of the oxides

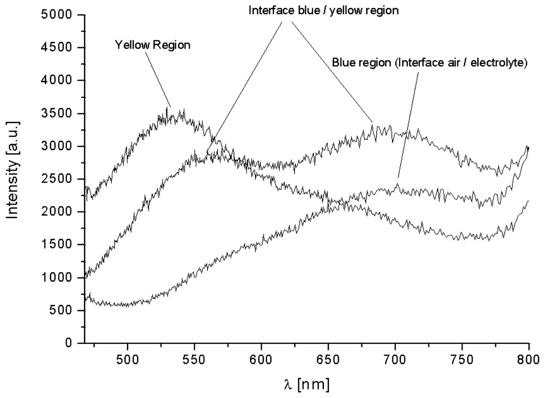

Fig. 3: PL-spectra of p-InP of different coloured regions after polarization at 3000mV for 180s in 1M HF