HOT CARRIER LUMINESCENCE DURING POROUS ETCHING OF GALLIUM PHOSPHIDE UNDER HIGH ELECTRIC FIELD CONDITIONS

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Gallium phosphide (GaP) can be made porous by electrochemical etching [1]. This is a very promising material (fig. 1,[2]) for photonic applications because it has a large refractive index, a large bandgap and pores with dimensions in the range of 100-500 nm. Optimisation of the etching process has yielded the strongest know random scattering medium for visible light to date [3].

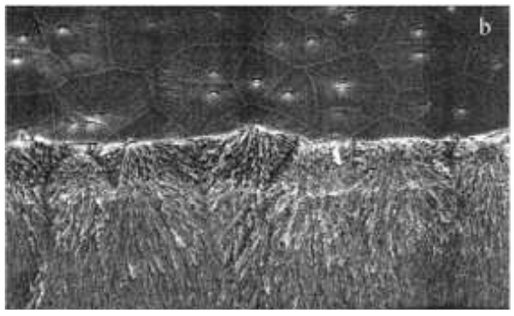

Fig. 1 Porous GaP, made by electrochemical etching

Electrochemical etching of *n*-GaP is generally carried out at strongly positive potential, corresponding to deep depletion. We investigated the relation between the electric field at the surface and the current density and show that the dissolution current is due to inter-band tunnelling. In addition, we observed for the first time light emission, i.e. electroluminescence (fig. 2), during etching. Remarkably, a large fraction of the emission has an energy larger than the bandgap. This suggests that hot carriers are involved in the luminescence mechanism. Besides this, the emission source can be used to study light scattering because the source moves with the interface as the porous layer thickens.

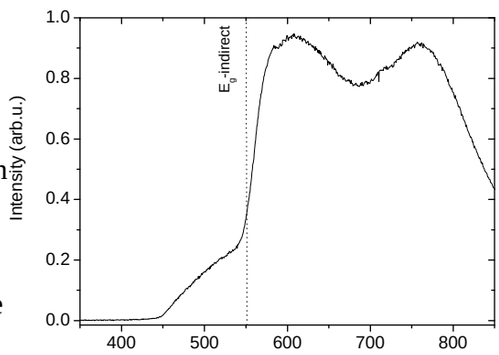

Fig. 2 Electroluminescence during electrochemical etching

1. B. H. Erne, D. Vanmaekelbergh, and J. J. Kelly, Journal of the Electrochemical Society 143 (1996) 305.
2. R. W. Tjerkstra, J. G. Rivas, D. Vanmaekelbergh, and J. J. Kelly, Electrochemical and Solid State Letters 5 (2002) G32.
3. F. J. P. Schuurmans, D. Vanmaekelbergh, J. van de Lagemaat, and A. Lagendijk, Science 284 (1999) 141.