

# Depth profiling of GaP/Si(001) heterostructures by XPS in combination with Ar gas cluster ion beam sputtering

O. Romanyuk<sup>1</sup>, I. Gordeev<sup>1</sup>, E. Ukraintsev<sup>1</sup>, O. Supplie<sup>2</sup>, P. Kleinschmidt<sup>2</sup>, T. Hannappel<sup>2</sup>, I. Bartos<sup>1</sup>, P. Jiricek<sup>1</sup>

<sup>1</sup>*Institute of Physics, Academy of Sciences of the Czech Republic, Cukrovarnická 10, 162 00 Prague 6, Czech Republic*

<sup>2</sup>*Photovoltaics Group, Institute of Physics, Ilmenau University of Technology, 98684 Ilmenau, Germany  
romanyuk@fzu.cz*

Integration of III-V compound semiconductors on Si(001) is strongly desired for fabrication of high-efficiency electronic devices. GaP is almost lattice matched to Si and, therefore, it could be used as a nucleation and buffer layer between Si and other III-V materials. The GaP/Si interface consists of heterovalent bonds. These give rise to an additional electronic charge which could be compensated by allowing atomic re-arrangement within a few interfacial layers [1]. The stability of abrupt and mixed GaP/Si(001) interfaces was investigated by ab initio DFT calculations [1]. A charge neutral ('compensated') interface with an intermixed Si/Ga layer, which yields an equal number of Si-Ga and Si-P bonds, was predicted to be energetically most stable. A strong prevalence of Si-P bonds at the GaP/Si(001) heterointerface was revealed by X-ray photoelectron spectroscopy (XPS) on very thin GaP epilayers [2]. In the present work, the atomic composition of the GaP/Si(001) heterointerface was investigated by X-ray photoelectron spectroscopy (XPS) in combination with Ar gas cluster ion beam (GCIB) sputtering. 20 nm thick GaP film was grown on Si by metalorganic vapour phase epitaxy (MOVPE). Calibration of GCIB sputtering rates for the cluster ion energies of 2.5 keV – 10 keV and a cluster ion size consisting of 500 – 2000 Ar atoms was carried out on bulk GaP(001) and Si(001) crystals. In contrast to the previous claims of non-destructive sputtering [3], destructive sputtering of GaP was mainly observed (Fig 1): peak shape of Ga 3d and P 2p core levels changed during GCIB sputtering at different energies. New peak components were identified as related to metallic Ga (Ga<sup>0</sup>) and disordered P. Nevertheless, in addition to disordered phase components, the interface-related components can also be identified in the P 2p, Ga 3d photoemission line of thinner GaP/Si(001) films.

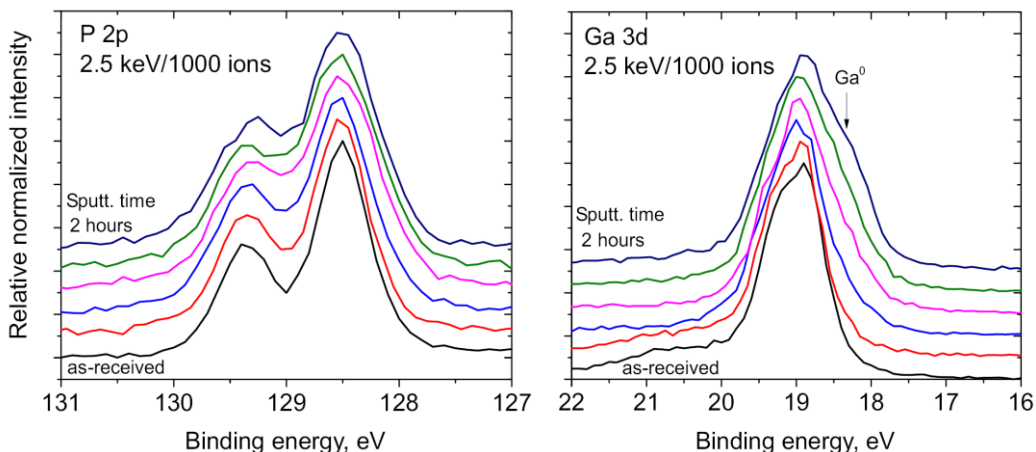


Fig. 1 – (left) P 2p and (right) Ga 3d core levels measured during GCIB sputtering of GaP(001).

## References:

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