

XRR & GiXRF combined analysis of Plasma Immersion

Ion Implantation Ultra-Shallow junctions.

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Many studies^{[1][2]} have shown the efficiency of the realization of Ultra-Shallow Junctions (USJ) by Plasma Immersion Ion Implantation (PIII) for semiconductor applications. Indeed, due to the intrinsic high performance of the technique at very low energy it allows to implant doping species with a high dose rate in the first nanometers of the wafers. For a complete characterization of the samples, the determination of the implantation profile and the total dose of elements is necessary. By measuring X-ray signals at various incidence angles, X-Ray Reflectivity (XRR) combined to Grazing Incidence X-ray Fluorescence (GiXRF) is known to provide the in-depth density and composition profile with a sub-nano resolution and in a non-destructive way^{[3][4]}.

Our study focuses on the in-depth profiling of AsH₃ PIII Ultra-Shallow junctions by XRR & GiXRF analysis. The simultaneous measurements have been made with a classical Mo-tube at 17.5keV. The influence of multiple implantation conditions have been tested (Dose of Arsenic, annealing, energy and temperature of implantation). The modeling of complete fluorescence spectra and reflectivity measurements has been realized by pre-existing software (Maud, jGixa)^{[5][6]}. This combined approach allowed us to obtain an evaluation of the total dose of Arsenic and of the implantation profile. A comparison of the results with Secondary Ion Mass Spectroscopy (SIMS) and other characterization techniques will also be made.

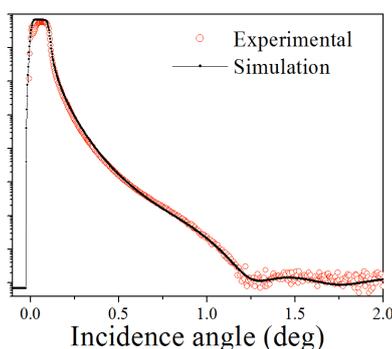


Fig. 1 : XRR profile of an USJ at 17.5keV (Mo-Ka line)

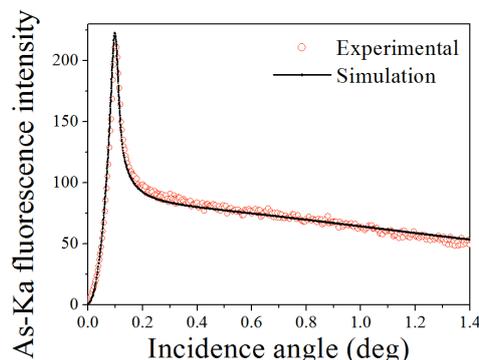


Fig.2 : As-Ka fluorescence profile in a USJ at 17.5keV (Mo-Ka line)

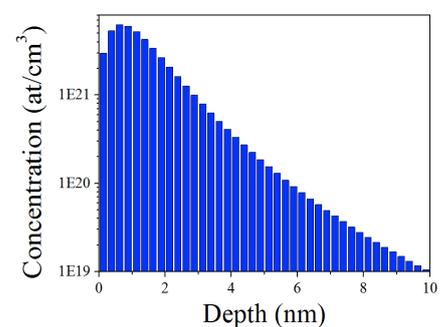


Fig.3 : Evaluated As implantation profile

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[6] - D. Ingerle, F. Meirer, G. Pepponi, D. Giubertoni, P. Wobrauschek, C. Strelj, Spec Acta B, 65 429-433,2010