Swift heavy ion induced nano porosity in GaSb

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GaSb is a narrowband semiconductor, interesting for opto-electronic, photo-voltaic and thermoelectric applications. We have recently discovered the evolution of nano-porous structures in GaSb following swift heavy ion irradiation [1, 2]. Nano-porous semiconductors differ significantly in their physical and chemical properties from their bulk counterparts, due to their microstructure (see e.g. [3]). The controlled fabrication of porous semiconductors thus paves the way for the development of new materials with application specific properties. GaSb films with an initial thickness of 2 μm, grown on InP substrates as well as bulk specimens were irradiated with different fluences and incidence angles with 185 MeV Au ions at the ANU Heavy Ion Accelerator Facility. The resulting nano-porous GaSb samples are investigated using a combination of high resolution structural characterization techniques including synchrotron based small- and wide-angle x-ray scattering (SAXS/WAXS), extended x-ray absorption fine structure (EXAFS), as well as imaging (SEM) and optical measurements (Raman- and FTIR-spectroscopy). GaSb exhibits swelling, several times larger than the initial layer thickness. The figure below shows GaSb grown on InP irradiated with different fluences at 30° incidence angle. The microstructure of the porous material is highly dependent on the fluence as well as the incident angle of the ion irradiation. X-ray diffraction and Raman-spectroscopy reveal an amorphisation at low fluence, followed by a fluence regime where small (<10 nm) crystallites inside the pore walls are created. The results aid in understanding the processes operational during pore formation in GaSb.

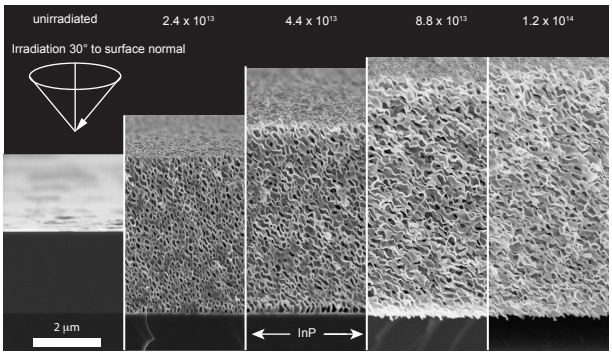

FIG. 1: GaSb film irradiated with 185 MeV Au ions at different fluences.

[1] P. Kluth, et al., *Appl. Phys. Lett.* **104**, 023105 (2014).

[2] C. Notthoff, et al., *Nuclear Inst. and Methods in Physics Research B* , in press (2017).

[3] L. T. Canham, *Appl. Phys. Lett.* **57**, 1046 (1990).