Microchanneling Investigation of ß-$FeSi_2$-Structures

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Semiconducting ß-$FeSi_2$ has currently attracted scientific interest, due to the fact that ß-$FeSi_2$ has a direct band gap of 0.8 eV [1,2]. This property makes it a special candidate for e.g. silicon-based micro-LED's. Single crystalline ß-$FeSi_2$ layers would even open possibilities for devices like micro-laser diodes. However, the synthesis of these structures is experimentally extremely delicate.

The temperature during implantation, the energy of the beam, the annealing procedures as well as the fluence and current density of the beam, the structure size of the layer etc. are all key process parameters and have to be optimized with respect to one another.

The first micro channeling analyses of $FeSi_2$-structures, which were produced with ion energy of 800 keV and sample sizes between 70-190 µm in diameters, were carried out. The combination of the two set-ups, the ion projector at the Ruhr University of Bochum and the micro-channeling set-up at the research centre Rossendorf, allows a fast synthesis as well as the analysis of the samples.

The implantation temperature of the samples was varied between 50–350 °C. The results show that bulk formation by Ostwald maturing depends on implantation temperature and structure size. Even if the layers do not show the desired crystalline characteristics, the investigations permit to draw conclusions about the damage of the surface layer with consideration of the bulk formation. This is of enormous interest, in order to optimize and model the embedding into a pn-structure as a step towards the development of a LED.

Additional Raman measurements showed clear fingerprints of ß-$FeSi_2$ [3].

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