ROBL-CRG	**Experiment title:** **Study of preferential orientation of SiC particles formed by carbon implantation into silicon**	**Experiment number:** 20_02_035
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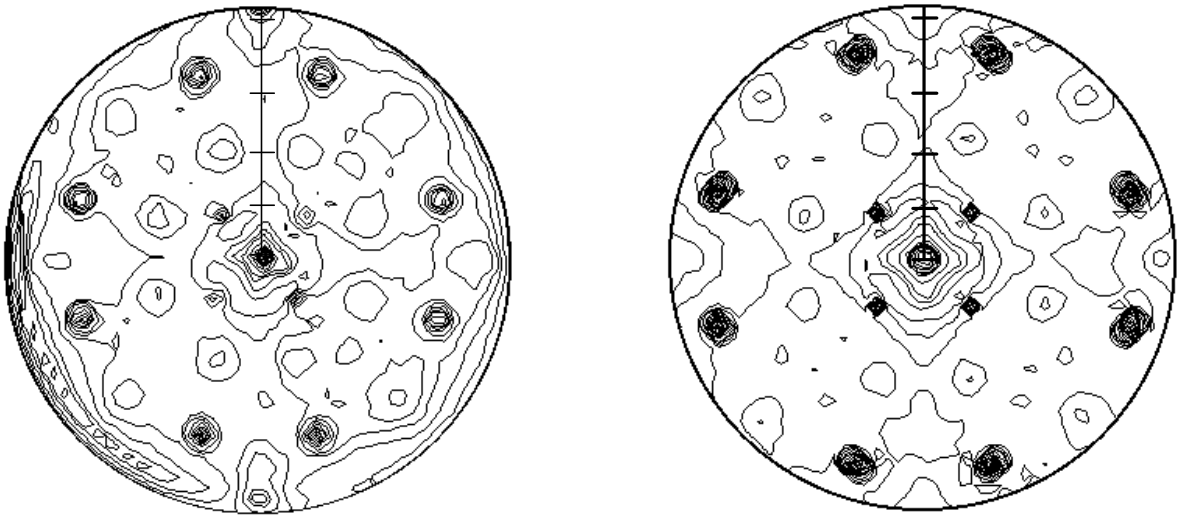
Report:

Due to its superior physical properties SiC is a useful semiconductor material for various devices requiring a wide bandgap. Thus, improvements in the epitaxial growth processes or synthesis of SiC by implantation of C into Si are of great interest. For technical application the SiC crystallites should be crystallographically aligned with the Si host lattice. Then one can combine the advantages of SiC with the well established Si technology in microelectronics.

Following earlier studies [1] of the strain and SiC particle formation in Si (experiment 20_02_001) now the orientation relationship between SiC crystallites and their Si matrix is investigated by texture studies. Below pole figures of SiC(311) are shown formed by implantation of $4x10^{17}$ cm^{-2} C ions into Si(001) at 500 °C (left-hand side) and 800 °C (right-hand side), respectively. The intense spots arise from the SiC{311} reflections, whereas the weak spots are formed by the extented tails of {331} reflections of the perfect Si matrix. The projection plane is (001). The polar angle scale is given in steps of 20°. and the iso-intensity lines in a logarithmic scale.



The SiC crystallites exhibit an orientation correlation with the single crystalline Si matrix. Three types of orientation are found by the present synchrotron x-ray diffraction studies, depending on the choice of implantation and/or annealing temperature:

(i) Random orientation like in a powder material: Only a small fraction of the crystallites shows this behavior.

(ii) Fibre texture with the axis parallel to the surface normal: For implantation at lower temperature (500 °C) this orientation type is more pronounced than for higher temperature. The growth of SiC at low temperature is determined predominantly by the concentration profile, which results in fibre texture.

(iii) High alignment of SiC to the Si matrix with orientation relations SiC<001> || Si<001> and SiC<110> || Si<110> due to a coherent growth of SiC in the Si matrix: For implantation at higher temperature the SiC growth is determined predominantly by the surrounding Si matrix lattice because the C can diffuse in the matrix during the implantation process. The coherence between the crystal lattices of SiC and Si was proven by TEM analysis.

An additional important result is that an elevated temperature (800°C) during implantation is more effective in forming an aligned crystallite distribution than a post-implantation treatment even at higher temperatures (1200 °C).

[1] F. Eichhorn et al., J. Appl. Phys. **86**, 4184 (1999).