ROBL-CRG	Experiment title: Study of strain and SiC particle formation in Si implanted with C ions of medium fluence	Experiment number: 20_02_001
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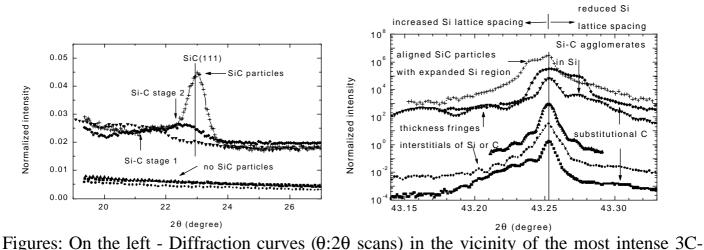
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Report:

Carbon is an important impurity in semiconductor silicon. It can deteriorate microelectronic device characteristics as leakage current and minority carrier lifetime or improve them due to the suppression of extended defects after implantation [1]. Moreover, implantation of C is applied for the formation of gettering layers [2] or preparing SiC crystallites. In dependence on the conditions of mixing C into Si the carbon is in different atomic surroundings. By implantation of C into Si the implanted region is in a non-equilibrium state and most of the C atoms are assumed to occupy interstitial positions. In thermodynamic equilibrium the solubility for C in Si is only 10⁻³ to 10⁻⁴ at.% C at 1200 to 1400 °C and the excess C is dissolved substitutionally or the new phase SiC is formed. It is known from previous investigations that SiC formation is not a single-step process [3]. The question how the implantation and annealing conditions influence the quality of the SiC layer can be only cleared up by studying the formation process in detail. Here we studied by synchrotron x-ray

diffraction the strain in the crystalline material (Si substrate and SiC particles) due to implantation and the first stages of forming the SiC phase in the Si lattice (details in [4]).

Implantation of C ions with an energy of 195 keV into Si wafers heated up to 800 °C results in an elastic distortion of the Si host lattice and in the formation of crystalline SiC particles or their prestages depending on implantation dose and temperature. Only a Si lattice deformation without growth of SiC was observed if the fluence does not exceed $5x10^{15}$ C ions/cm². After implantation of C ions up to $4x10^{17}$ cm⁻² at a temperature of 500 °C, agglomerations of Si-C and an altered state of Si lattice deformation are found. By implantation of $4x10^{17}$ ions/cm² at 800 °C, particles of the 3C-SiC (β -SiC) phase grow, which are aligned to the Si matrix [4].



On the right - Diffraction curves of the Si(400) reflection revealing the lattice strain component perpendicular to the sample surface. Characteristic features and their reason are marked.

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