Grazing-Incidence Diffraction Strain Analysis of a Laterally patterned Si wafer treated by Focused Ge and Au Ion Beam Implantation — J. Grenzer1, L. Bischoff3, and U. Pietsch2 — 1Forschungszentrum Rossendorf e.V., Institute of Ion Beam Physics and Materials Research, P.O.Box 51 01 19, D-01314 Dresden, Germany — 2University of Potsdam, Institute of Physics, Am Neuen Palais 10, 14469 Potsdam, Germany

Strain analysis of a laterally patterned Si wafer was carried out utilizing X-ray grazing-incidence diffraction performed at the ID10B at the ESRF. The lateral patterning was done by focused ion beam implantation using an AuGeSi alloy liquid metal ion source. Samples were prepared by either a 35 keV Au+ ion beam (dose: 0.3 × 1014 cm−2) or by a 70 keV Ge++ ion beam (dose: 8 × 1014 cm−2). It was shown that a periodical defect structure consisting of both implanted and not implanted stripes is created due to ion beam implantation. The induced strain distribution measured, however, shows no periodicity. This can be only explained by an overlap of the strain fields created in each implanted stripe.

We found a maximum strain for the Au implanted samples in a depth of about 20 nm (Δα/α = −1, −3 × 10−4 for the Au samples); for the Ge sample in a depth of ≈100 nm (Δα/α = −1, 2 × 10−4). At depths 500 nm below the sample surface the strain of the Ge sample becomes smaller than the detection limit (Δα/α < 2 × 10−5). Using this technique we were able to create a buried Ge layer with a thickness of about 200 nm and an averaged Ge content of about 1%.

Vacancy complexes with oversized impurities in Si and Ge — M. Mohr, M. Machón, J. Maulitzsch and C. Thomsen — Institut für Festkörperphysik, TU Berlin, Hardenbergstr. 36, 10623 Berlin

Dopelresonantes Raman Spektrum in Germanium — M. Mohr, M. Machón, J. Maulitzsch and C. Thomsen — Institut für Festkörperphysik, TU Berlin, Hardenbergstr. 36, 10623 Berlin

We present measurements of the Si L-edge of polycrystalline Si and amorphous SiO2 — M. Volmer1, C. Störmann2, J.A. Sohnes3, A. Hoil3, G. Venko4, S. Streith5, and M. Tolan6 — 1Institut für Physik, Universität Dortmund, Deutschland — 2Div. X-ray Physics, Dept. Physical Sciences, University of Helsinki, Finland — 3Institute of Materials Science, Darmstadt University of Technology, Germany — 4ESRF, Grenoble, France

We present measurements of the Si L-edge of polycrystalline Si and amorphous SiO2 using the x-ray Ramanscattering technique (XRS). The momentum transfer dependence of XRS gives access to additional monopole excitation channels for the high momentum transfer regime, where the dipole approximation is no longer valid. The Si L-edge spectra show clear momentum transfer dependence with respect to their total shape and will be compared to calculations using a Bethe-Salpeter equation-based approach including core-hole and lifetime effects. The Si L-edge of amorphous SiO2 exhibits distinct fine structure along with pronounced momentum-transfer dependence. These spectra will be discussed in terms of the interface-clusters mixture model for the structure of amorphous SiO2 on the basis of a disproportionation of SiO into Si and SiO2.
Phosphorous donor wave function in strained silicon layers

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The wave function of shallow donors such as phosphorous in silicon can be determined very accurately by electron spin resonance. In particular in the context of quantum computing, the manipulation of the donor wave function currently receives considerable attention. Here, we report on the influence of strain on the hyperfine interaction in P-doped Si. In contrast to previous experiments, where the effects of external strain on bulk Si:P were investigated, we use fully strained thin Si:P layers on virtual SiGe substrates grown by CVD where high Ge contents of up to 30% in the substrate allow much higher strains to be investigated. For detection of the spin resonance in these thin epilayers, electrically detected magnetic resonance is used. Si:P on relaxed Si$_{0.84}$Ge$_{0.16}$ has a hyperfine interaction of 25 G, which is reduced by 40% from the unstrained case, in excellent agreement with the extrapolation of the data obtained on bulk Si:P.

Ferromagnetic Mn–doped Ge

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Heavily manganese–doped germanium with a reported Curie temperature $T_C$ of up to 116 K [Park et al., Science 295 (2002), 651] is of interest as a potential material for spintronic applications. Samples have been grown on Ge(100) substrates by MBE with manganese concentrations ranging from 0.02 at.% up to 52 at.%, as determined by elastic recoil detection analysis and EDX. The substrate temperature was approx. 225°C. Raman scattering and UV/VIS reflection measurements indicate a good crystalline quality of the epitaxial films up to a Mn concentration of 10 at.%, where the Ge TO Raman peak shows a FWHM of 5.4 cm$^{-1}$. Raman modes attributed to Mn–Mn vibrations as well as a low concentration of holes in Hall effect measurements indicate that clusters or intermetallic compounds are formed. SQUID magnetization measurements for samples with a Mn concentration of 3–20 at.% clearly show the presence of several magnetic phases: (i) the ferromagnetic Mn$_5$Ge$_3$ with $T_C = 285$ K and (ii) a low-temperature phase with a remanence that disappears at 30 K.