ESRF

Experiment title:	**Experiment number:**
X-ray **diffraction** and grazing incidence diffraction on graded $Si_{1-x}Ge_x$ buffer layers grown on patterened substrates	HS-575

Beamline:	**Date of experiment:**	**Date of report:**
BM 05	from: 25 Mar 98 to: 30 Mar 98	25 Aug 1998
Shifts:	**Local contact(s):**	*Received at ESRF:*
15	Dr. A. Freund	0 7 OCT. 1998

Names and affiliations of applicants (* indicates experimentalists):

Dr. L. Tapfer, C.N.R. S.M.-PASTIS, Brindisi, Italy
*Dr, C. Giannini, C.N.R. S.M.-PASTIS, Brindisi, Italy
Doz.Dr.V.Holy, Masaryk University, Brno, Czech Republic
*Dr. Petr Mikulik, Johannes Kepler Universitat Linz, Austria
ProfDr.G.Bauer, Johannes Kepler Universitat Linz, Austria
*Julian Stangl, Johannes Kepler Universitat Linz, Austria
*Yan Zhuang, Johannes Kepler Universitat Linz, Austria

Report:

Two types of Si-based heterostructures have been investigated during this beam time. Reciprocal space maps (RSMs) of partially relaxed, graded $Si_{1-x}Ge_x$ buffer layers grown by Low Energy DC-Plasma Enhanced Chemical Vapor Deposition (LEPECVD) have been measured using a position sensitive detector (PSD) setup. These samples were provided by ETH Zurich within the framework of an ESPRIT-project (LOCO).[1,2] Symmetrical and asymmetrical maps were recorded at different wavelengths. Figure 1 shows the (004) and (224) maps of sample #5441. From RSMs the strain distribution as a function of the Ge content of the buffer layer was obtained (Fig. 2) showing efficient strain relaxation as required for subsequent growth of strained Si-channels for two dimensional electron gas confinement. The strain distribution in this particular sample deviates, however, from the usual pattern known from similar, MBE grown samples. This might be due to an overshoot in the feedback control of the Ge source during sample growth. Additionally, specular reflectivity scans of thin (typically 15-20 nm), boron-doped hetero bipolar transistor (HBT) $Si_{1-x-y}Ge_xC_y$ structures have been measured in order to determine their layer thicknesses and interface roughnesses (Fig.3).

1. C.Rosenblad, T.Graf, J.Stangl, Y.Zhuang, G.Bauer, J.Schulze, H.von Känel, Thin Solid Films, in print.
2. C.Rosenblad, H.von Känel, J.Stangl, C.Penn, G.Bauer, J.Schulze, I.Eisele, C. Giannini, M.Gusso, E.Carlino, L.Tapfer, Proc. 26th Int.Conf.Phys.Semicond., World Scientific 1998

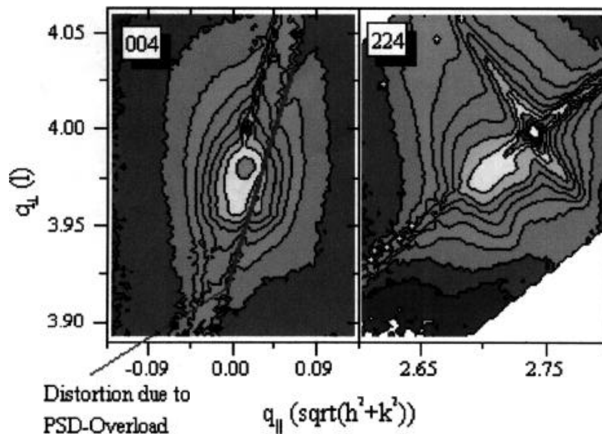

Figure 1. Symmetrical (004) and asymmetrical (224) reciprocal space maps of LEPE-CVD grown sample 5441, measured at a wavelength λ=1.31Å using a PSD.

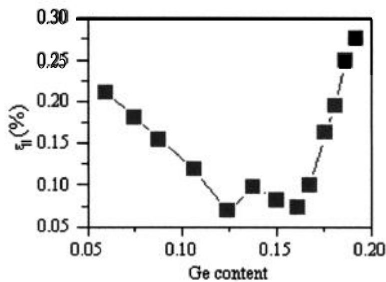

Figure 2. In-plane strain distribution of LEPECVD grown sample 5441 as a function of the Ge content in the buffer layer.

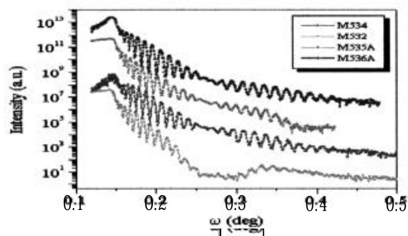

Figure 3. Specular reflectivity scans of MBE-grown SiGeC epilayers (HBT structures)