



<b>Experiment title:</b> <b>Investigation of step-bunching in SiGe and SiGeC epilayers for heterobipolar transistor (HBT) structures</b>	<b>Experiment number:</b> HS-887	
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**Report:**

We have investigated 5 period Si/Ge/Si dot multilayers grown by solid source molecular beam epitaxy on slightly miscut (001) oriented Si substrates. Each multilayer sequence consists of 6.5ML pure Ge and Si spacer layer. On top of the superlattice a Si cap layer and additional Ge dot layer have been deposited.

Measurements have been performed on a set of three samples with different Si-spacer thicknesses of 76, 50, and 25 nm, respectively, in order to study the influence of the Si spacer between the Ge layers on the strain field modulation, which is responsible for a vertical and lateral ordering of the dots in the subsequent layers. The final aim is to determine conditions where the ordering of dot positions are optimized, and hence also the size distribution of the dots, which is crucial for the optical properties of the structures, and which is strongly influenced by the ordering, is narrowest.

Using high resolution x-ray diffraction, reciprocal space maps as well as rocking curves ( $\omega$ - $2\theta$ -scans, Fig. 1) have been measured around (004), (115) and (206) reciprocal lattice points. Diffusely scattered intensity characteristic for dots formation was observed (Fig.2). From the intensity distribution in reciprocal space information on the lateral and vertical correlation and on shape and size of the islands has been obtained.

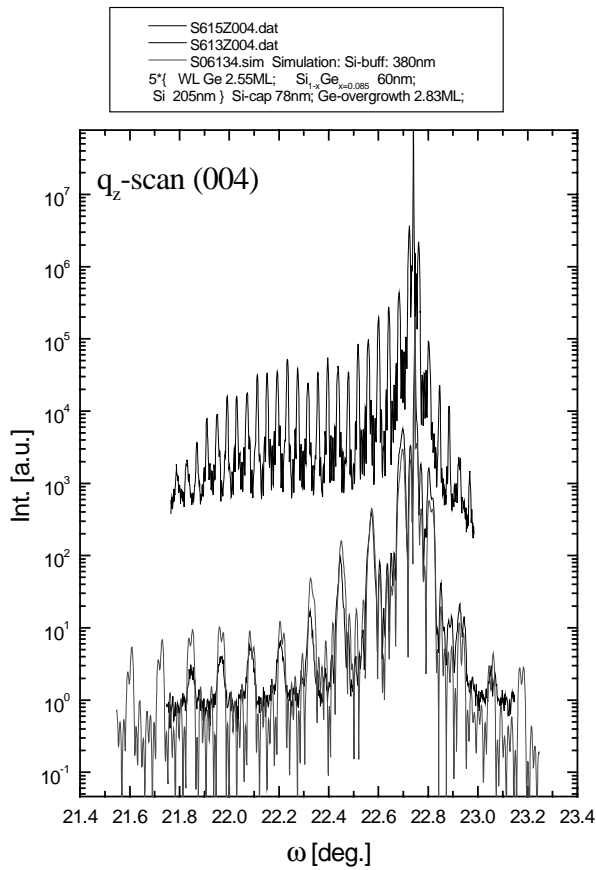


Fig. 1:  $\omega$ - $2\theta$  scan around (004) for samples S0615 and S0613 (black: measurement, red: simulation).

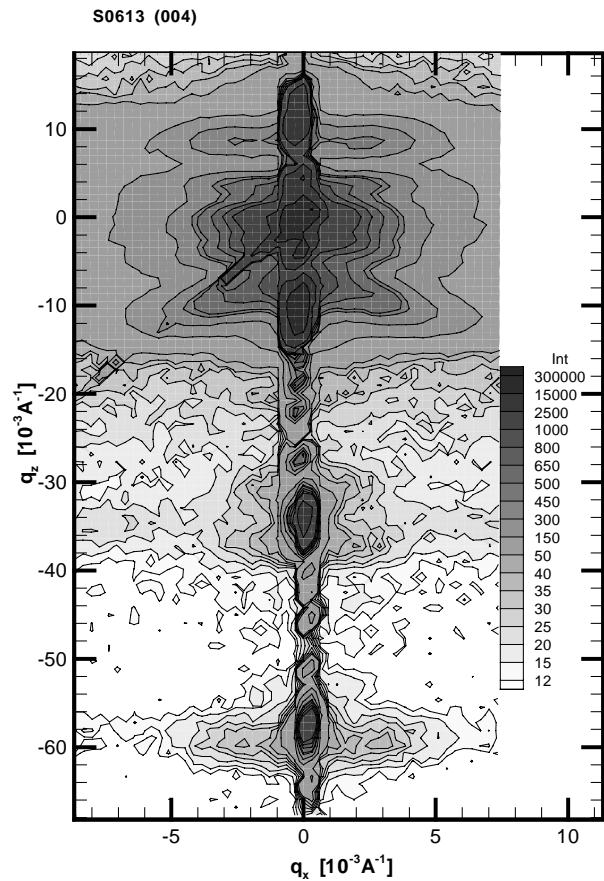


Fig. 2: (004) reciprocal space map around  $SL_{2...1}$  of sample S0613.

Additionally, we measured with small beam size in a double crystal diffraction arrangement the lateral uniformity of layer parameters of SiGe heterobipolar transistor structures in different device test structures and across 4-inch wafers. The results are important for the calibration of laboratory measurements at special larger areas in the wafer center.

The rocking curves of 44 SiGe(C)/Si(C) superlattice structures with different position and concentration of carbon and four different annealing conditions were measured. The obtained results are important for the understanding of the diffusion mechanisms in SiGeC structures and especially of the influence of substitutional carbon on the Si/Ge interdiffusion.