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Report:

We have investigated 8 period SiGe/SiC/Si multilayers grown by solid source molecular beam epitaxy with 20% Ge-content and C-contents from 0% to 1.5%. The superlattices have been grown strain symmetrized, i.e. with the strain in the SIC layers compensating the strain of the SiGe layers (except for zero C-content). Coherent reflectivity (ω–2θ-scans, Fig. 1) as well as o-scans and 2θ-scans through the diffusely scattered intensity distribution have been measured in order to evaluate the roughness of the interfaces in the multilayers and its correlation properties both parallel and pependicular to the growth direction. No resonant diffuse scattering sheets could be observed, indicating a rather small roughness or only weak replication of interface roughness in the accessible lateral length scales. From a first analysis of the data, an interface roughness of 4Å and a vertical correlation length lower than approx. 100Å for lateral lengthscales over 4000Å are obtained, and virtually no influence on the roughness and its replication of the C-content is observed.

Furthermore, we investigated Si/SiGe multilayers grown on (113) oriented Si substrates with a miscut of 0.36°. Reciprocal space maps around (113) and (3 15) Bragg reflections have been recorded in triple axis geometry, using a single-bounce (111) Si analyzer crystal. Due to step flow and step bunching during epitaxial growth, a very regular terraced surface structure has formed, leading to satellites in $q_{\|}$-direction accompanying every superlattice peak

(Fig. 2). From the intensity distribution in reciprocal space, the period and shape of the terrace structure can be determined.

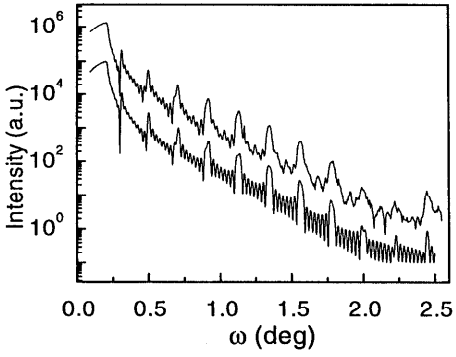

Fig. 1: ω–2θ scan of specularly reflected intensity for sample M-SG 577 (measurement plus simulation).

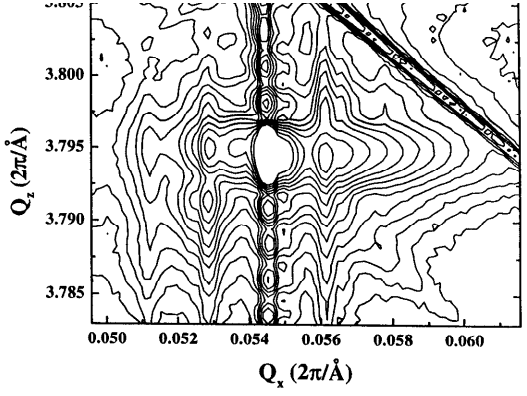

Fig. 2: (113) reciprocal space map around SL_0 of sample R95 1.

Additionally, we measured the rocking curves of eleven SiGe/Si superlattice structures with different carbon incorporation (0.1, 0.2, and 0.5%; (i) in the SiGe layers, (ii) in the Si layers, and (iii) in the whole layer stack) after annealing at 700, 750, 800, and 850°C. These measurements give information about the influence of the substitutional carbon on the SiGe interdiffusion. It was found that the interdiffusion increases with increasing carbon content, and there is also a strong influence of the carbon position on this behavior.