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Names and affiliations of applicants (* indicates experimentalists):

R. A. Cowley, A. Babkevich, M. Bentall

Clarendon Laboratory, University of Oxford, Parks Road, Oxford OX1 3PU, U.K.

Report:

One of the most topical areas of semiconductor physics concerns the properties of quantum dots and their possible future applications in technology. The full exploitation of quantum dots requires that they are placed regularly on a surface or preferably on a three dimensional lattice. One of the ways of achieving this in systems with large lattice mismatch like Si/Ge is by growing wavy superlattices in which the thickness and the concentration of Si/Ge alloy varies laterally along the superlattice and is coherent from one layer to the next. The x-ray diffraction experiments allow determining the wavelength of the modulations and the size and strain of the quantum dots.

We have studied by x-ray diffraction Si/Ge_xSi_{1-x} superlattices grown on Si substrate by MBE at the Institute of Microstructural Sciences in Ottawa which exhibit wavy interfaces. To cover a wide range in Ge composition the measured samples had x=0.37, 0.46 and 0.56 and periodicity of 157 Å, 174 Å and 166 Å correspondingly. The scattering was measured at two different wavelengths of 1.12716 Å (at 11 keV) and 0.619916 Å (at 20 keV). This allowed to measure the x-ray scattering for wave-vector transfers near few symmetrical (004), (008), (00.12), (00.16) and asymmetrical (115), (118) and (22.12) reflections. Scans were performed by varying the wave-vector transfer along the [110] and [001] directions and by reciprocal space mapping of some areas, see Figs. 1 & 2.

Reciprocal space maps near the on-axis (004) reflection, Fig. 1a, and off-axis (115) reflection, Fig. 1b, show a high quality superlattice which is perfectly lattice matched to the substrate.

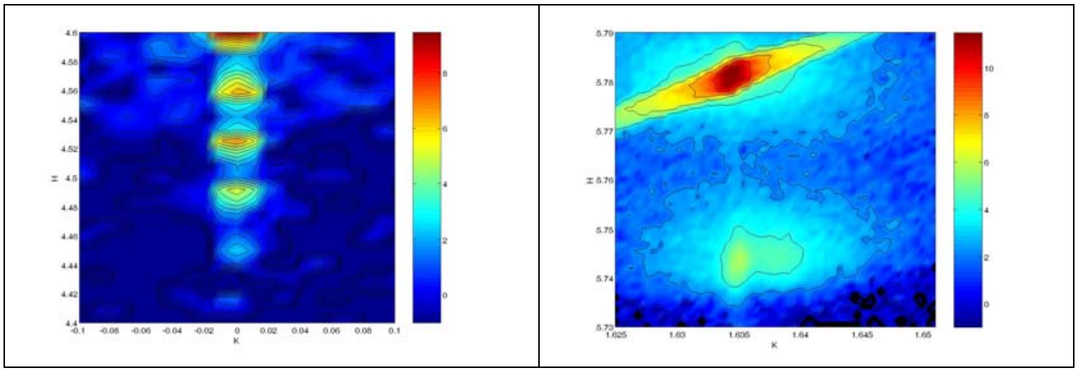

Fig. 1. Reciprocal space maps near the (004) Bragg relection (a) and near the (115) reflection (b).

Fig. 2 shows a typical scan through one of the superlattice peaks near the (004) Bragg reflection when the

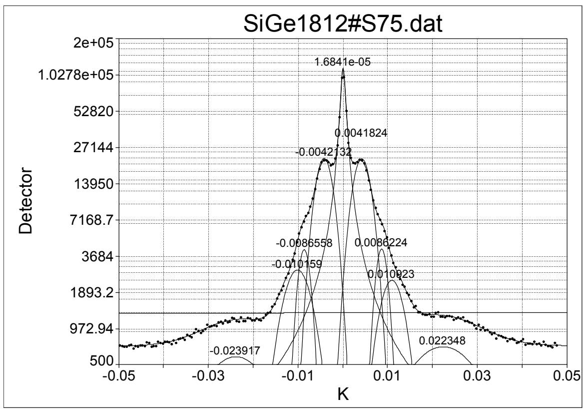

Fig. 2. Scan through a superlattice peak near the (004) Bragg reflection with the wave vector transfer *K* changing along the [110] direction.

wave vector transfer *K* changes along the [110] direction. The scan reveals two strong side peaks originating from a periodic arrangement of ‘dots’ in a wavy superlattice and the spacing between the peaks gives an average periodicity of ‘dots’ of about 1500 Å and the width of the peaks corresponds to a coherence length of 1400 Å. Similar measurements near the other Bragg reflections reveal that the scattering is indeed from the ‘dots’ rather than from the dislocations or other imperfections.

More detailed analysis is currently in progress and should provide further information about the in-plane structure of the dots.