XMaS the UK-CRG	**Experiment title: The Structure of Semiconducting Thin Films and of InSb Quantum Dots**	**Experiment number:** 28-01-045
Beamline: **BM 28**	**Date of experiment:** from: 07-Oct-99 to: 13-Oct-99	**Date of report:**
Shifts:	**Local contact(s):** Anne Stunault	*Received at XMaS:*

Names and affiliations of applicants (* indicates experimentalists):

R.A. Cowley: Oxford Physics, Clarendon Laboratory, Parks Road, Oxford OX1 3PU

A. Babkevich: Oxford Physics, Clarendon Laboratory, Parks Road, Oxford OX1 3PU

Report:

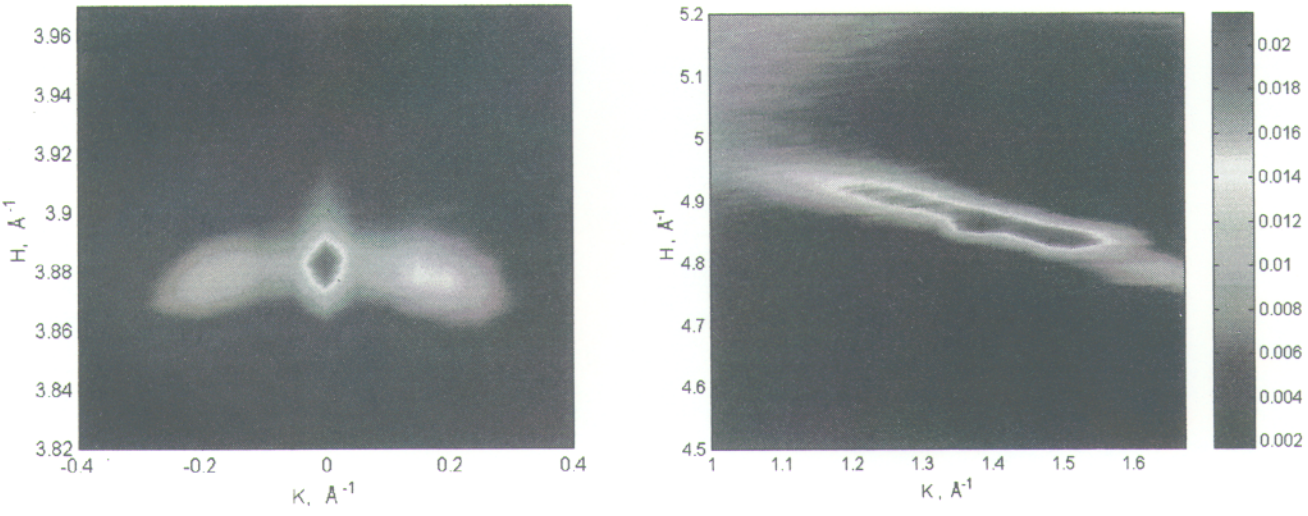
The InSb was grown on GaAs substrates by MOVPE at few different temperatures from 460^0 C to 500^0 C. The temperature of growth should alter the nucleation size/number density of InSb islands and the idea was to reduce the growth temperature to a point where strained InSb quantum dots are grown rather than relaxed InSb islands. We have measured two groups of samples grown with different metalorganic alkyls as precursors: the trimethylantimnony [TMSb] and a new precursor, trisdimethylaminoantimony [tDMSb], which was used for the first time in this experiment and which is believed to give a much more uniform range of islands as the temperature of growth is changed.

We have measured scattering around the 004, 115 and, when it was possible, also around the 002 reflection of InSb. From the position of Bragg peaks the averaged lattice constants of the InSb dots were determined. For the samples grown at 470 ^{0}C and 480 ^{0}C they are a=6.4754 ±0.0040 Å, i.e very similar to the bulk InSb (a=6.47877 Å), while the InSb grown at slightly higher or lower temperatures, 460 ^{0}C and 500 ^{0}C, is strained up to 0.6 %.

The width of the peaks in the [001] direction allows to determine the averaged thickness of the dots and the width in the [110] and [1-10] directions allows to characterize the correlation length in a plane. We have found that a more relaxed InSb corresponds to higher averaged thickness of InSb: the samples grown at 470 ^{0}C and 480 ^{0}C have essentially bigger dots, 270-400 Å high on average, compared to the samples prepared at 460 ^{0}C and 500 ^{0}C when the dots are 90-160 Å high.

The in-plane scattering is essentially different from what we have previously observed in the GaSb films [1] and does not show any evidence of the regular arrays of misfit dislocations (see Fig. 1). The correlation length in the [110] direction determined, for example, for the 480 ^{0}C and 500 ^{0}C samples was about 100-250 **Å.** The results in Fig.1 also suggest that the dots consist of the domains, which are tilted by about 2^0 with respect to the growth direction and the tilt is different in different samples.

The plan for the experiment was not fully completed due to a problem outside the beamline, when the beam was unavailable for 27 hours. Otherwise the X'Mas beamline operated impressively well.



(a) (b)

Figure 1. The x-ray scattering from the dots of InSb measured around the 004 (a) and 115 (b) reflections in the sample grown at 500^{0}C.

References

[1] A.Yu. Babkevich, R.A. Cowley, N.J. Mason & A. Stunault, X-ray Scattering, Dislocations and Orthorhombic GaSb, *in press*.