ESRF	**Experiment title:** Investigation of strain distribution in epitaxial lateral overgown GaAs and GaSb layers using the X-ray rocking curve imaging technique	**Experiment number**: MA-623
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Report:

The aim of experiment MA-623 was to use the X-Ray Rocking Curve Imaging (RCI) technique to study crystallographic quality and distribution of strain in GaSb and GaAs layers grown by liquid phase epitaxial lateral overgrowth (ELO) on SiO_2 masked GaAs substrates. Despite high efficiency of defect filtration there are still open questions about strain in ELO semiconductor structures (see [1] for a review). For example, lattice and thermal expansion mismatch of various components of the ELO structure as well as an interaction of the crystalline layer with the amorphous mask may lead to significant deformation of the crystal lattice. To address these issues two types of samples, schematical cross-sections of which are shown in Fig.1, were studied. First, a fully-overgrown GaAs/GaAs ELO layer was chosen for RCI analysis to avoid any lattice mismatch strain that might interfere with the basic effects occuring in the system. This allowed us to study a well-known effect of ELO wing tilt toward the mask. A higher local concentration of dislocations and the formation of low angle grain boundaries might be expected when ELO wings tilted in opposite directions merge. Therefore, the region of coalescence front where adjacent ELO stripes met was also carefully analyzed. The second sample studied consisted of separated GaSb ELO stripes grown on GaAs substrate coated by planar GaSb buffer and SiO_2 mask (Fig. 1b). It was used to study an impact of lattice mismatch between the ELO material (GaSb) and the substrate (GaAs) on crystallographic perfection of laterally overgrown epitaxial layers.

Rocking Curve Imaging is a method which combines the features of X-ray imaging (very high spatial resolution) and X-ray diffractometry (very high angular resolution). By using a Frelon camera, series of diffraction images (plane-wave topographs) were recorded and then analyzed pixel-wise in terms of local rocking curves by using dedicated software [2]. The diffraction images of ELO layers were recorded in two characteristic sample positions, i.e. with the diffraction plane parallel and perpendicular to the seeding lines. As an example, Fig. 2 shows the typical RCI maps of fully-overgrown GaAs ELO layer collected for two orientations of diffraction plane. The shape of of the ELO coalescence front is clearly visible. Also, the wing tilt magnitude and its spatial distribution can be readily determined from the Bragg angle distribution (not shown). RCI maps of highly lattice mismatched

GaSb/GaAs ELO layer (Fig.3) show the grain structure of the layer. The high spatial resolution offered by RCI allows precise analysis of such local lattice distortions. In particular, a typical size of the GaSb grain of ~100 µm has been found. Further interpretation of the data collected is in progress. Then, all experimental results will be compared with those obtained by X-ray diffraction with the use of high resolution laboratory diffractometer.

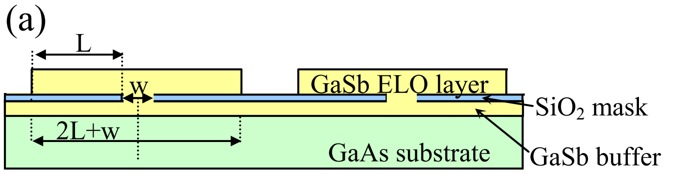

Fig. 1a. Schematic cross-section of fully-overgrown GaAs/GaAs ELO structure. The windows are 10 µm (w) wide and are spaced by 100 µm.

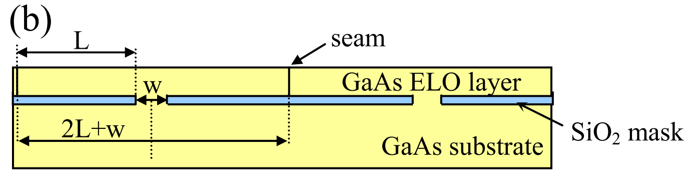

Fig.1b. Schematic cross-section of GaSb/GaAs ELO structure. The windows are 6 µm (w) wide and are spaced by 500 µm. L is the length of the ELO wing.

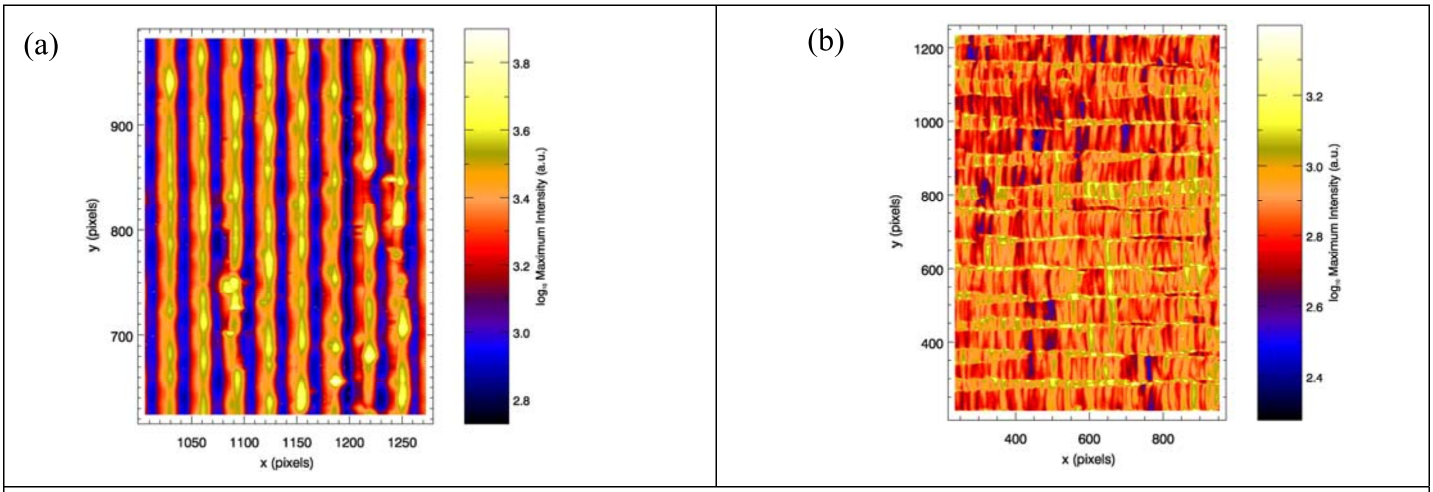

Fig. 2. Spatial distribution of local diffraction intensity in fully-overgrown GaAs/GaAs ELO structure measured with the diffraction plane perpendicular (a) and parallel (b) to the seeding lines.

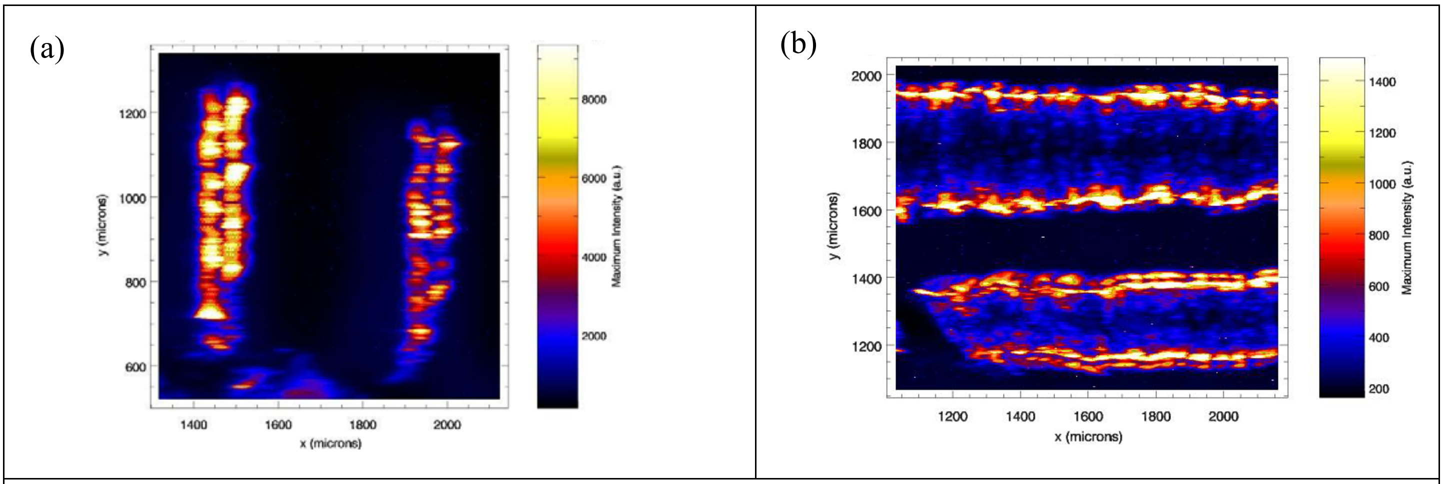

Fig. 3. Maps of local diffraction intensity in GaSb/GaAs ELO sample measured with the diffraction plane perpendicular (a) and parallel (b) to the seeding lines. The structure of microblocks is clearly visible.

[1] Z.R. Zytkiewicz, Thin Solid Films **412** (2002) 64.
[2] D. Lübbert, T. Baumbach, J.Appl.Cryst. **40** (2007) 595-597.