ESRF	**Experiment title:** Rocking Curve Imaging with high spatial resolution used for investigation of GaN layers grown by epitaxial lateral overgrowth	**Experiment number:** HS-2399
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Shifts: 9	**Local contact(s):** Lukas Helfen	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):
Daniel Lübbert*, Humboldt-Universität, Berlin, Germany
Tilo Baumbach*, ANKA, Forschungszentrum Karlsruhe, Germany
Petr Mikulík*, Mazaryk University, Brno, Czech Republic
Lukas Helfen*, EADQ, Fraunhofer-IZfP, Dresden, Germany and ESRF, Grenoble
Petra Pernot*, ESRF, Grenoble
Dušan Korytár, Slovak Academy of Science, Bratislava, Slovakia

Report:

The aim of experiment HS-2399 was to investigate epitaxially laterally overgrown Gallium Nitride (ELO-GaN) samples using spatially resolved X-ray diffraction *alias* Rocking Curve Imaging (RCI). ELO is a well established crystal growth method, but still suffers from the problem of crystallographic misorientation of the laterally overgrown regions (*wing tilt*), whose origins remain largely unknown.

To gain detailed information on the nature of this wing tilt, we investigated a set of ELO-GaN samples by Rocking Curve Imaging, using very high resolution both in the spatial and angular dimensions (1.4 μm and 0.0005°, respectively). A series of samples grown on different substrates (SiC and Al_2O_3) and at different growth temperatures was studied. Complete RCI data sets of 6 samples were collected at X-ray energies of 10.0 and 11.0 keV. The numerical analysis of the RCI could be completed during the beamtime, using specially prepared software.

The results show that this kind of laterally periodic structure can successfully be investigated by direct real-space imaging methods such as RCI. Local rocking curves of individual crystallites in the ELO wings could be recorded with sufficient resolution and statistics. The wing tilt in single lateral periods was found to be measurable. Detailed crystallite-misorientation maps could be retrieved (see Fig. 1), as could maps of local diffraction peak widths separately for the "window" and the "wing" areas. *Local* GaN crystalline quality as derived from these maps proved to be much better than expected from laboratory (integral) rocking curves. As a surprise, it was found that the wings split into lateral sequences of 2–8 smaller crystallites, under certain conditions. This splitting is not simply correlated to the growth conditions, and deserves further investigation in the future.

Further interpretation of the results in collaboration with the crystal growers is in progress and will provide insight into the roles of the various factors (substrate material, wing widths, growth speed, etc.) influencing the tilt values and the subgrain structure of the ELO wings. This analysis will be complemented by measurements with microscopy methods (AFM, SEM).

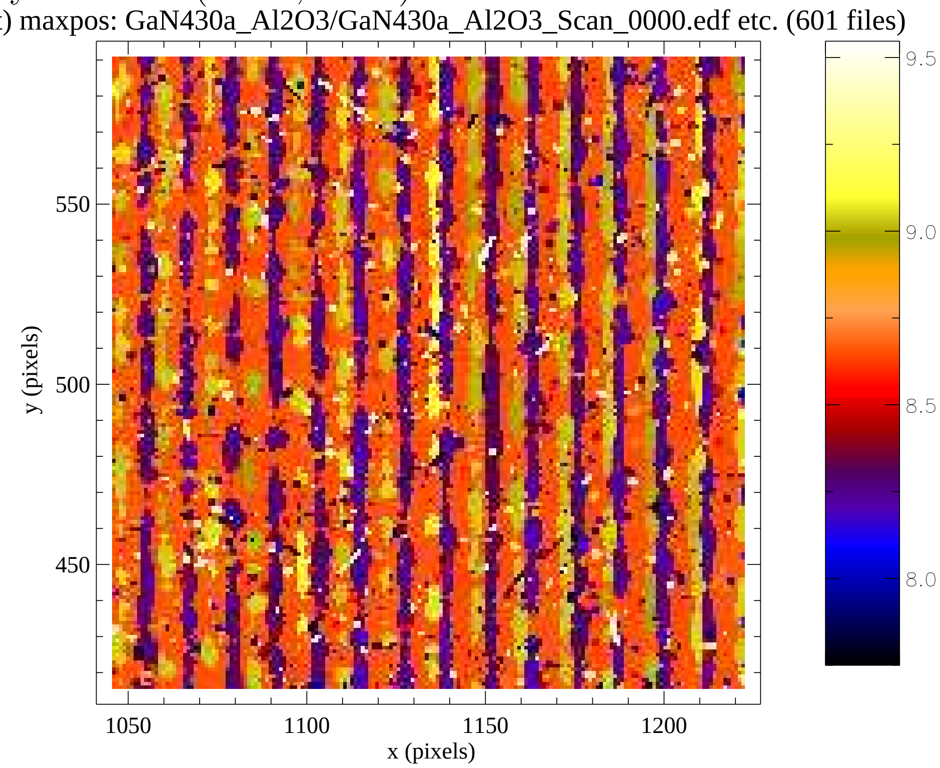

Figure 1: An experimental Bragg peak position map showing the lateral periodicity of the sample and the arrangement of stripes. Inside each lateral period, three main groups of crystallite orientations can be distinguished, corresponding to the material in the "windows" and the left and right "wings". Relative tilt values are on the order of 0.4°–0.5°.

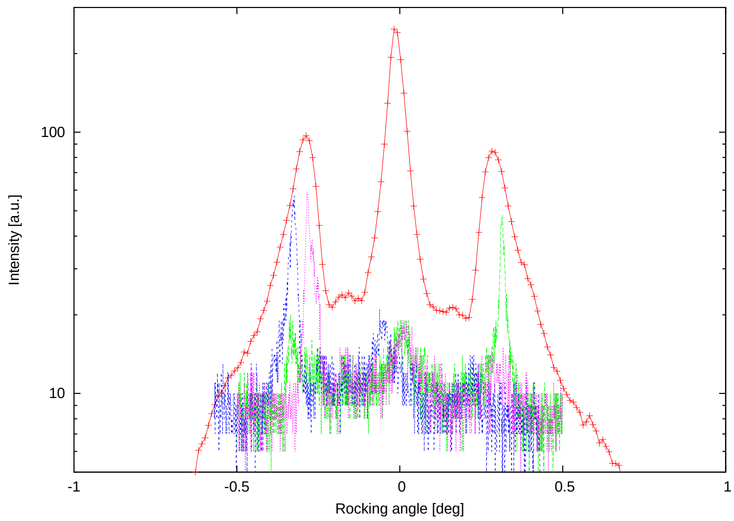

Figure 2: Laboratory rocking curve (top, red) and three selected *local* rocking curves extracted from the RCI data of the same sample. The comparison shows that the widths of Bragg peak from single pixels areas (1.4 μm in size) are very narrow. The *local* crystal quality is thus rather good. Peak broadening in the integral curve is found to be due mainly to a spatially inhomogeneous distribution of wing tilts.