ESRF	**Experiment title:** **Strain measurements near domain walls in Mg-doped $LiNbO_3$**	**Experiment number**: MA-2629
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Report:

1) Technical aspects

Experiments were performed successfully on 2 distinct Mg-doped $LiNbO_3$ single crystals. The areas of interest were localized by taking advantage of the anomalous effects originating from the close enough match between the Nb-edge and the energy of the beam (8 keV). This anomalous effect creates a contrast between 180°-domains where there shouldn't be one in normal diffraction conditions, which made it possible to localize quickly the areas of interest.

2) Results obtained

We review below the objectives stated in the proposal. Generally speaking, the fitting of the kmaps for actual strain calculation is not yet done, so that no statement can be made at this stage about the strain evolution at the domain wall. However, intensity maps obtained at different angles already give strong indications of success.

- The full strain tensor in the vicinity of the domain walls in Mg:$LiNbO_3$, which is a novelty for this compound, especially at this unprecedented spatial resolution (< 1µm).

→ kmaps were successfully measured at the (006) and (00 12) reflections at domain walls. In this particular geometry however, only a few off-axis reflections were accessible and we had difficulties in identifying them conclusively. We therefore decided to focus on the main reflections, which will give only the main component of the strain tensor.

The objective of the spatial resolution has been achieved since the beam size was c.a. 200x300 nm, which is 3 times better than any published results. Both coarse maps, for identification of the areas, and fine maps and linescans for optimal resolution were performed.

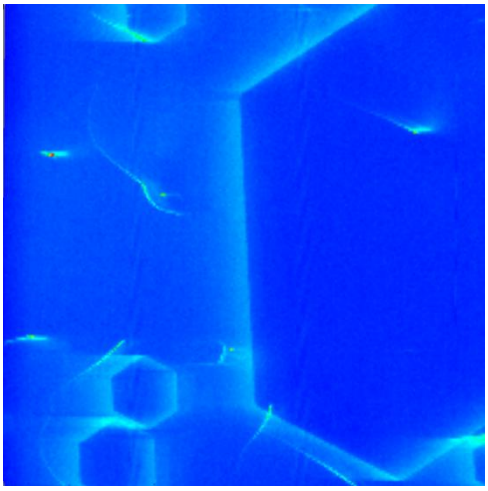

Fig. 1: Example of a coarse 200 x 200 µm² kmap acquired on a Mg-doped $LiNbO_3$ single crystal showing typical hexagonal-shaped domains.

- The evolution of the strain field during annealing, which will crucially enable us to distinguish between extrinsic (defects, partial poling) and intrinsic strains at domain walls.

→ kmaps were successfully measured at the (006) reflections at 4 temperatures according to the following sequence: 25°C; heating to 65°C and 200°C; cooling to 27°C. Measurements performed at 25°C and 65°C give indications on extrinsic and intrinsic strains at domain walls. Measurements performed at 200°C and at 27°C after cooling depend only on the intrinsic strain at domain walls [1].

- The differences in the strain field with and without illumination, which is needed to clarify the role of strain in the conductivity properties of domain walls under illumination.

→ kmaps were successfully measured at the (006) reflections at domain walls with and without UV light. A small diode of wavelength 285 nm was used to illuminate the first sample and a wavelength of 300 nm was used for the second one. They are both within the wavelength range where conductivity at domain walls has been measured [2].

In summary, the experiment was very successful in the sens that all necessary data were acquired. Analysis is on its way.

[1] P. Reichenbach *et al.*, Applied Physics Letters **105**, 122906 (2014)

[2] M. Schröder *et al.*, Advanced Functional Materials ***22***, 3936 (2012)