ESRF	**Experiment title:** KTP and lithium niobate under alternated electric fields using the stroboscopic diffraction topography.	**Experiment number:** HS-417
Beamline: ID19	**Date of experiment:** from:30-Jan-98 to:01-Feb-98	**Date of report:** 25-02-98
Shifts: 6	**Local contact(s):** PERNOT Etienne (PLUO E)	*Received at ESRF:* 02 MAR. 1998

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Report:

KTP (KTiOP04) is an ionic conductor which displays electric polarization and one dimensional conductivity. An interesting electric field related reduction of extinction is observed on such a sample (and others such as $LiIO_3$) : in the low absorption case, the diffracted intensity is enhanced several times by the application of a moderate field (10^3-10^4 Vm^{-1}) directed along the c axis. The X-Ray projection topographs show the occurrence, under field, of many lines parallel to the c polar axis [1]. Previous experiments performed at the ESRF (using projection and section topography) suggest that the origin of these lines is a strongly anisotropic and inhomogeneous polarization in channels connecting the electrodes [2].
The purpose of the experiment done was to observe, on the 001 reflection, the formation (and also the vanishing) of these polarized channels within the crystal when applying an electric field, using section topography (thus lines appear as points).

The formation and the vanishing of these lines are too fast (<1 s) to be observed using traditional topography (the exposure time of a section topograph being of the order of 3s). A way to observe these transient phenomena under field, is to reduce the time the sample is exposed to the beam to a very short instant, and repeating the recording as many times as needed to have a sufficient contrast on the film. If the electric field is applied periodically and synchronized with a pulsed beam, this

technique is well known as being stroboscopy [3]. It is of course possible to investigate different moments of the period (in our case, from formation to vanishing of points, using section topography).

In the case of stroboscopic diffraction topography on KTP under electric field, as the relaxation of the sample is a low phenomenon, the frequency used for stroboscopy has to be small. This is the reason why a mechanical chopper has been developed. It is available for a range of frequencies from 1Hz to 4OHz with a pulse width which can be either 0.25%, 1% or 2.5% of the period. By using stroboscopy, with a pulsed beam of 2.5% of a period 0.5s, the 'apparent' exposure time is about 2 minutes. Such an experiment is only possible at the ESRF : anywhere else the exposure time would be dramatically huge).

During this experiment we had to adjust three parameters to observe periodic formation of points on section topographs : the amplitude and duty cycle or the applied electric field, and also the frequency. We managed to find a compromise between them with the following result : a low frequency of 2Hz is used, and a square electric field of high amplitude ($180 V.cm^{-1}$) is applied to the sample, with a duty cycle of 5% or 10%. This gives rise to a quasi-periodic phenomenon inside the crystal.

With such an experimental set up, moments of the period can be observed, including the formation and relaxation of the polarization phenomenon. First results are the following :

dynamic and static phenomena are different. That spots the fact that stroboscopy is an interesting technique for dynamic phenomena.

- all over the period, points (revealing polarized channels) appear on section topographs and when their number is high, they change into lines (planes parallel to the plates of the crystal). However, this transient phenomenon is so fast that the formation of the lines can not be seen step by step and we jump from points in high number to lines (SR films were used because they do not need a high exposure time, but their resolution is too low for this study),

One interesting fact is that the formation and the relaxation process of the sample do not seem to be the same. The formation is very fast and is not properly observed (the applied electric field was too high).

To conclude, two points can be emphasized:

in an experimental point of view, ESRF is the adapted instrument for low frequencies stroboscopy.

-physically, in the KTP case, we obtained encouraging results such as a periodic polarisation of the sample, and good topographs of different moments of the period. Nevertheless, further experiments should be done using a shorter pulsed beam, to distinguish different important phenomena.

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