	Experiment title: Study of ultra-acoustic vibration modes in piezo-electric devices by white beam stroboscopic topography	**Experiment number**: HS1476
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Report:

Since the experiments were made at the the end of July, just before vacation time, this will be a preliminary report. We did not have time to analyze in details the 200 hundred pictures which have been registered!

We had two objectives in this experiment:

- To measure the attenuation coefficients in a vibrating semi-convex resonator and to check if the measurements were in agreement with the theory (Tiersten 1979). Previous measurements made at ESRF were accurate in one direction only but new measureùments using other difraction conditions were necessary.
- To try understand discrepancies found in the contrast between experiments made at LURE and at ESRF.

We also wanted to test a new phase shifter especially build to work at ESRF.

We may already assert that our objectives have been fullfilled.

Measurement of attenuation coefficients

Stroboscopic topography is the only method to directly measure the deformation state of a vibrating piezo-electric device (Capelle and al. 2001). For this purpose a number of section topographs are recorded through all the device, moving a fine slit (20 µm wide) from top to bottom. The attenuation coefficients are obtained, measuring the deformation of the fringes in the section topographs.

In the present experiment we have been able to register series of section topographs *using two different diffraction vectors* perpendicular one to the other, thus this will allow to measure the attenuation coefficients along two orthogonal direction with a much better accuracy than in the previous experiment where we only had registered a series for *one diffraction vector* only. We now have the data to measure the attenution coefficients α_5 and β_5 in two orthogonal directions with the same precision.

The measurements will be made in the next months but we may assert that we now have all the results needed for this.

Contrast of section topographs

In the previous experilment we found that the number of fringes observed in the section topographs at ESRF was not in agreement with the observations made at LURE (Capelle & al. 2001). For instance, when using the 5^{th} overtone, 5 black lines were visible at ESRF, 6 at LURE.

One main difference between LURE and ESRF is that at ID19, the high collimation of the beam allows to locate the film at a long distance from the crystal (from 70 cm up to 180 cm in our experiments). This very interesting feature is essential for our experiments since it permits to observe the geometric amplification of the deformation of the lines which allows to measure the attenuation coefficients.

We have registered a series of section topograph, for the same location on the crystal, varying the distance between the crystal and the film from 5 cm up to 180 cm. We have been able to observe how the shape of the black lines change and we found that at short distances, up to 20 cm, the images are in agreement with the observation made at LURE. But for reasons not yet explained the contrast of one of the lines decreases and it vanishes so that, at long ditances, not only the deformation of the fringes is enlarged, but 5 fringes remin visible. We now must find a theoretical model to understan these contrasts but the origin of these discrepancies is now understood: it is linked to the distance between the film and the crystal only.

Experimental setting

To obtain images of good quality in stroboscopic topography it is necessary to use a high frequency generator of high quality and also a very good phase shifter needed to be able to observe the various states of the vibration (very stable frequency with a precision better than 1%, phase adjustable to a few degrees) . Since the old one, used in the past, was out of date, we have build a new one which was tested for the first time. Its precision is very good, much better than the old one, however one problem remains: it is very difficult to adjust manually the frequency to avoid a small shift of the phase during the time of an experiment because the time needed to record an image may be of the order of a few minutes. Thus a reference to the frequency of the beam will be needed in future experiments to enhance the precision and autoùmatically correct the phase. We intend to modify our setting to introduce this feature.

Conclusion

We are well aware that this report is only a preliminary report since we still have to analyze our results. However we can already assert that our main objectives have been fullfilled. Our next objective will be to continue in the same direction analyzing acoustic surface waves by reflection topography.

Bibliography

B. Capelle, J. Détaint & Y. Epelboin (2001) J. Appl. Crsyt. In the press
Tiersten H.F. & Smythe R.C., (1979) J. Acoust. Soc. Amer., **65**, 6, 1455-1460