ESRF	**Experiment title:** Stroboscopic imaging of the interaction of acoustic waves with defects in piezoelectric devices	**Experiment number:** HS-40.5
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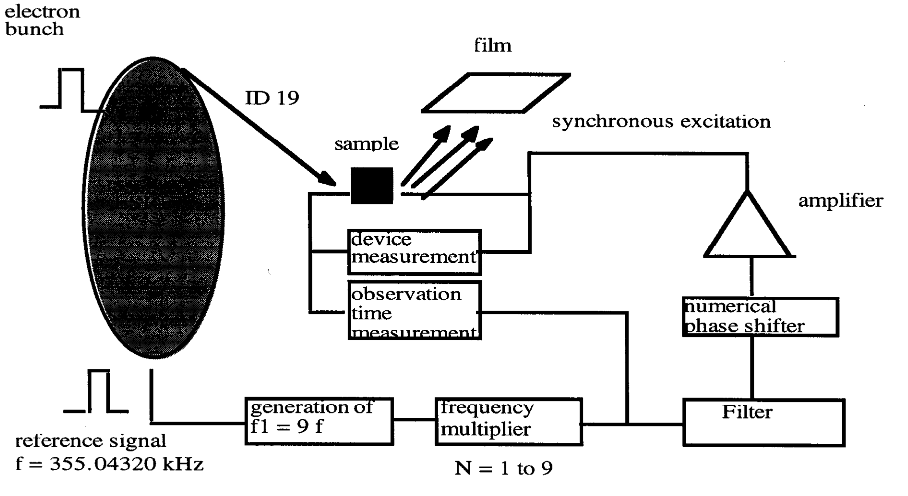
Report:

Piezoelectric quartz resonators have been studied using a stroboscopic white beam topography setting (fig. 1). These resonators (AT-cut planar-convex resonators) contain various defects.



There have been prepared so that their resonance frequency is 3.1958888 Mhz for the partial mode 3 and 0.6390776 Mhz for the partial mode 5.

A number of new features, never observed at other synchrotron stations (LURE, France), have been observed:

- a - the dislocations present a triple black-white-black contrast when a simpler double contrast (black and white) only was observed. By means of simulations we have been able to demonstrate that this arises from the presence of an anharmonic at 0.35 Å when the chosen wavelength was 0.7 Å [l-2]. The image due to the harmonics presents a triple contrast, the image due to the main wavelength contains only a classical black and white contrast and when both are added a triple contrast is clearly visible. Although not new the existence of higher harmonics must be kept in mind at ID19, to explain the observed contrasts for classical defects in white beam topography.

- b - vibration fringes appear outside the area under the electrodes and extend till the edges of the crystal. They show a lack of acoustic energy never seen before and suggest that the resonators should be shaped differently to avoid such artefact. This new contrast was certainly made visible because of the short wavelength used in this experiment (0.3 Å about) and the high resolution of the ID 19 beam line [3].

- c - Recording section topographs using the stroboscopic setting for crystals vibrating with the partial mode 5, we have observed fringes « en fuseau » which arise from the creation of new wavefields at each depth, inside the crystal, where the strain presents a maximum. The width of the « fuseau » increases when the amplitude of the vibration increases. This contrast is not yet fully understood and new experiments will be needed: changing the main parameters of the experiment (wave length and film to crystal distance) we expect to be able to determine if this contrast arises from the presence of harmonics or originates from the high coherence of the beam.

Studying non vibrating crystals in conventional white beam Laue topographs we have been able to observed fringes at the limit of the Z growth sectors boundaries. This feature has never been observed before in synthetic grown crystals and cannot been explained neither by the presence of stacking faults nor new contrasts arising from the presence of harmonics. This may be an effect of the coherence of the beam.

New experiments will be needed to explain these features which are of interested both from the theoretical point of view (what is the influence of the coherence?) or from the technical point of view since ESRF has allowed characterize defects never seen before (like stacking faults in Z growth bands) or leak of acoustic energy which is a problem for the industry.

[l] ESRF workshop on diffraction imaging (1997), Grenoble December

[2] Joumees de 1'Association Française de Cristallographie (1998), Orleans february

[3] to be presented at International frequency Control Symposium, Pasadena, USA, june 1998