ESRF

Experiment title:
ULTRA-SONIC WAVE MODULATION OF THE BRAGG-FRESNEL LENS

Experiment number:
MI-107

Beamline: BM5

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Report: Circular BFL structure was manufactured on the 400 μm Si (111) substrate with the following parameters: innermost zone radius 8 μm, outermost zone widths 0.4 μm, aperture 200 μm (Fig. 2). In order to avoid deformations which can be introduced into the thin BFL substrate by transducer a thick *(8 mm)* Si crystal has been used as BFL-transducer interface. The piezoelectric transducer has been pasted to the back side of the thick crystal with low-melting organic glue meanwhile the BFL substrate has been attached, one polished face to another, by means of non-solidified adhesive emulsion. The 36° Y-cut Lithium Niobate transducer with fundamental frequency of about 30 MHz has generated the quasi-longitudinal ultrasound wave with wave vector perpendicular to the crystal surface. The basic experimental parameters are: incident radiation energy E=9.89 keV, reflection Si (555), Bragg angle θ_B=87° and BFL focal distance is F=62.5 cm. Taking into account the demagnification factor of 64, the focal spot size produced by BFL can be estimated as to be 2.3x3.9 μm^2.

The X-ray total reflected power (TRP) was registered with PIN-diode detector and the beam size of few millimeter squares. By this means the acoustic spectrum of the vibrating system has been obtained, which allowed to pick out the optimal resonant frequency. Next the dependence of the TRP on the amplitude of a signal applied to the transducer has been measured. The voltage amplitude was scanned within the range of O-3 V for the ultrasound frequency of about 12 MHz corresponding to one of the resonant peaks in the TRP spectrum (Fig. 1a).

For the characterization of the X-ray focusing properties of BFL undergoing ultrasonic excitation a 10 μm pinhole has been scanned in the focal plane by means of two mutually perpendicular micropositioners. The radiation transmitted through the pinhole was registered with Si PIN-diode detector. The plots shown in Fig. 2b clearly demonstrate that ultrasound excitation of the circular BFL allows to increase the X-ray flux in **BFL** focus by a factor of 2 which is very close to the theoretical limit.

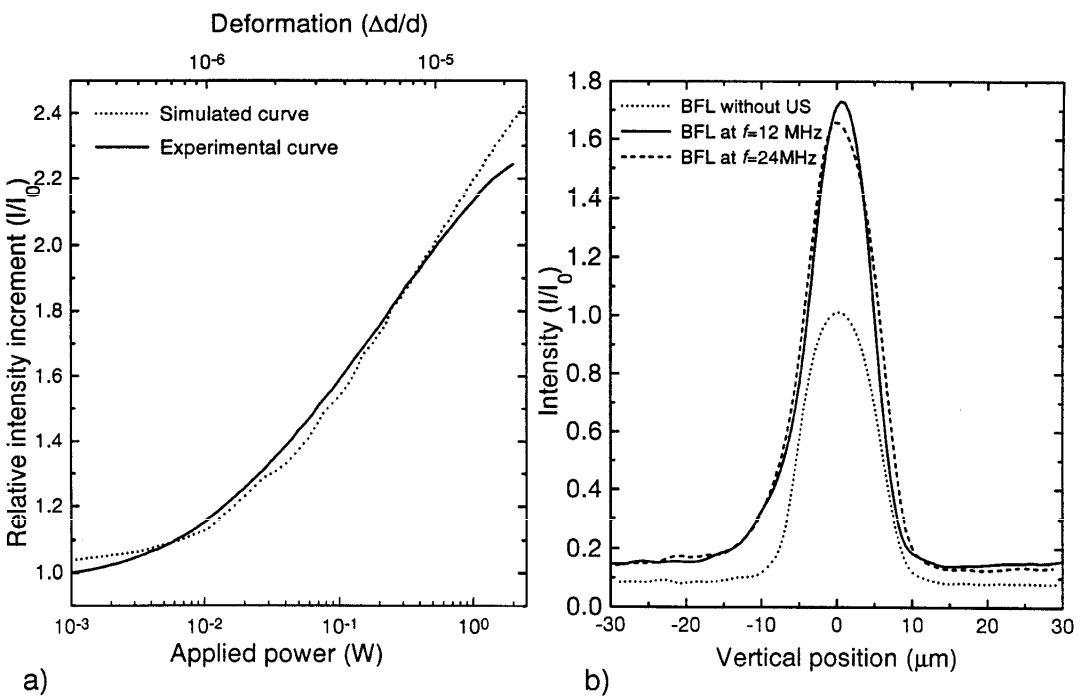

Fig. 1. a) gain in the TRP versus the applied power, b) focus intensity distribution obtained by means of cross scanning with 10μm pinhole.