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Report:

A vibrating silicon crystal was tested as a bandpath-tunable monochromator on the high-resolution topography beamline. The crystal of dimensions $(15x6x1.7)cm^3$ was set-up with the 111 reflection in Bragg geometry. A cooling device build for this study guaranteed temperature stability of the monochromator. Compressional standing waves of frequencies 1Mhz(λ_s=1cm), 3Mhz and 10Mhz (λ_s=1mm) were excited propagating parallel to the [111] direction. Experiments were performed at 18keV and 60keV photon energy. At 60keV the reflecting sample volume reaches a maximum. Analyser scans of the silicon 111 reflection were measured as a function of sound wave amplitude with the monochromator vibrating at resonance. A maximum gain in the integral reflected intensity of 20 was observed. Topographies of the 111 reflection were taken at different vibration conditions and at various distances from the monochromator to the film in a range from 7cm to 385cm. The topographies show regularly striped intensity patterns, created by orientation contrast due to surface acoustic waves (SAW).

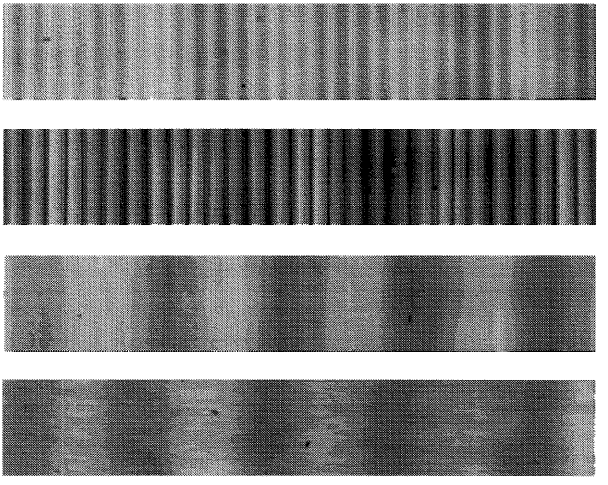

Fig. 1: Topographies of the Si 111 reflection at sample to film distances 7cm, 48cm, 256cm and 385cm (f=3.28MHz) at constant vibration amplitude. The SAW focus the diffracted radiation at different distances from the monochromator. The focal distance varies with SAW amplitude.

A study of the topography contrast after the analyser crystal at various angular settings on the rocking curve gave additional information about the contrast formation. The SAW deformation gradient increases the initial beam divergence, clearly not what is wanted for this type of monochromator. The tunable reflected intensity may be still of interest for low energy diffraction optics whenever a larger beam divergence accompanying the intensity gain is acceptable. Further steps towards the realisation of a vibrating one dimensional gradient crystal for Bragg geometry are: 1) Efficient damping of SAW by absorbing materials or a monochromator shape unfavourable for the propagation of SAW, and 2) Excitation of compressional waves of higher frequency, shorter wavelength and larger amplitude to maximize the longitudinal deformation gradient in the useful surface-near monochromator volume.