

Whilst the primary experimental aims of observing clear diffraction from coherent phonons were met with excellent results, unfortunately we did not have the opportunity to specifically investigate the enhancement of such phonon modes in thin crystalline films. The primary ESRF diagnostic used for these measurements – the sub-picosecond X-ray streak camera – developed a fault at the beginning of the run, and was only available for 2 of the 8 days of HS-1122/1123. Such teething problems are not unknown with the commissioning of such state-of-the-art equipment, and the ESRF staff worked day and night to fix the problem. A great deal was learnt from this process, and we fully expect that future experiments will yield a far greater wealth of data. That said, the results we have obtained are extremely interesting.

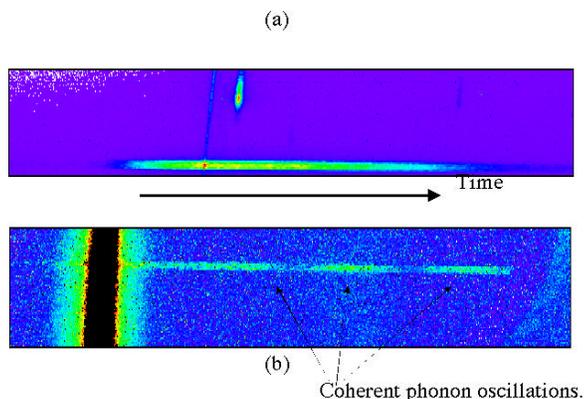


Figure 1 Picosecond diffraction from (a) unperturbed InSb crystal and (b) from crystal within which coherent phonons have been launched by irradiation with 100-fs laser

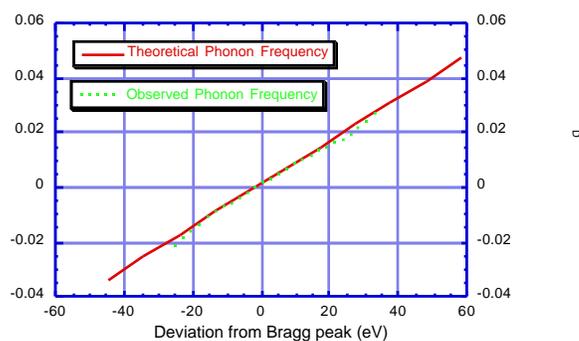


Figure 2: Observed phonon frequency as a function of deviation from Bragg peak compared with results from dynamical-diffraction-theory.

Theoretical modelling is ongoing in order to interpret the results. Our initial analysis will concentrate on the phase and delay of the oscillations of the X-rays diffracted from the phonons with respect to the laser excitation pulse (known with an accuracy of order 1 picosecond). We believe that this may well yield information on the relative roles of the fast time-scale (sub-picosecond) deformation potential and the slower electron-phonon relaxation in setting up the strain profile within the first few picoseconds of excitation. Direct information on the relative roles of these mechanisms has hitherto been illusive. Preliminary modelling of the data is being published in SPIE proceedings, and plans for further publication of this work in J. Phys. D and another journals are in progress.

Publications arising thus far from this work: “Femtosecond X-ray Diffraction: Experiments and Limits: SPIE proceedings no. 4143 (San Diego, August 2000) (to be published).
+ 2 papers in preparation.