ESRF	**Experiment title:** **Three-dimentional diffraction space studies of polycrystalline CVD diamond films.**	**Experiment number**: ME-356
Beamline: ID10 B	**Date of experiment**: from: 24/04/02 to: 30/04/02	**Date of report**: 24/02/03
Shifts: 15	**Local contact(s)**: Dr Oleg Konovalov	*Received at ESRF:*

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Report:

Three-dimensional reciprocal-space mapping was performed to determine the true microstrain: that is, the distribution of strain within individual grains: and to calculate the precise lattice parameters and deviation from near-perfect samples. In order to accomplish this, Bragg reflections from individual grains were isolated [1,2]. This was achieved by increasing the 2θ resolution and by reducing the axial divergence of the beam, resulting in a smaller probe and partially eliminating the effect of projection on to the diffraction plane along the perpendicular direction. A suitable divergence was achieved by using two pairs of slits, placed after the monochromator and before the detector respectively. The incident beam size was reduced to 20 μm^2 to ensure that only a small part of the sample was illuminated. The experiments were carried out at ESRF, ID10B.

The samples were a selection of CVD specimens grown under different conditions. The dominant surface orientation of the crystallites were <100>, <110> and <311> . Previous measurements (Powder diffraction and SEM studies) showed that a small amount of nitrogen incorporated during the growth results in a strong <100> texture. Series of reciprocal space maps were taken at ID10 B, surrounding the 004, 220 and 311 reflections from the specimens using 0.16 nm X-rays [1]. The experimental set-up is shown in Fig. 1. The reciprocal-space maps collected, display Bragg reflections from several crystallites appearing at similar values of 2θ and ω positions but separated in tilt angle, χ. Fig. 2 shows a constructed three-dimensional map obtained from the nitrogen doped sample. Our analysis [1,2] showed that the broadening seen in the ω-2θ scan direction may correspond to dislocations, since point defects would distribute more or less evenly leading to a shift in the peak position rather than a distribution of strain. The broadening seen in the ω-scan direction could be caused by lattice curvature or finite size of the coherently diffracting regions.

Comparison of the results showed that introducing a small amount of nitrogen (1-4%) during the growth results in reducing the strain along the growth direction: a conclusion which, as it relates to individual grains, is probably only obtainable by reciprocal-space mapping.

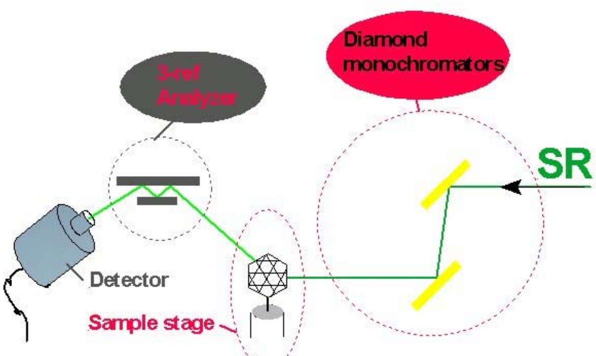

Fig. 1. A schematic disgram showing the experimental arrangement at ID10 B.

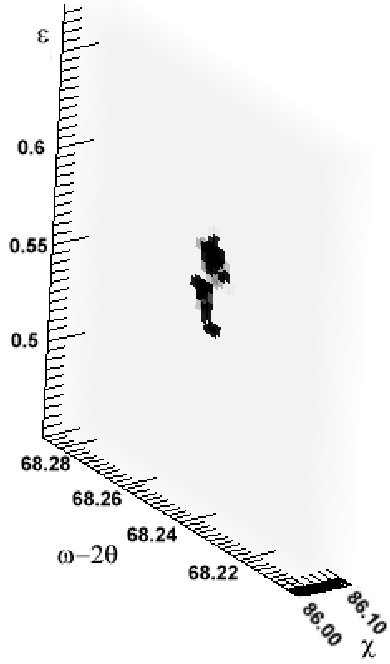

Fig. 2. A 3-D isointensity presentation of a series of reciprocal-space maps at 68% of the maximum intensity around the 004 reflection obtained from a CVD diamond film using 0.1 nm X-rays. χ was increased by steps of 0.02° between each map.

References

1. Golshan M., Fewster P.F., Laundy D. and Moore M., "Application of three-dimensional reciprocal space mapping for studying polycrystalline CVD diamond" in *Methods for Diffraction Analysis of Materials*" (to be published by Springer Verlag, 2003).

2. Golshan M., Laundy D., Fewster P.F., Moore M., Whitehead A., Butler J.E. and Konovalov O., 'Measuring strain in polycrystalline CVD diamond films' (accepted for publication in *J. Phys. D: Appl. Phys.*, Feb. 2003).