ESRF	**Experiment title:** Development of high resolution strain scanning on BM16 - II	**Experiment number:** **HS-478**
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Report:

The proposal was for an allocation of beamtime to enable the proposers and beamline staff jointly to develop techniques and equipment for medium-energy high-resolution strain scanning on BM16. Hardware and software were developed to enable two techniques to be investigated, the 'Traditional' $\sin^2\psi$ near-back-reflection method using a wavelength of 1.498695 Å and the transmission technique, derived from more recently developed neutron methods, using a wavelength of 0.348527 A.

In the traditional method, using wavelengths of around 1.5 Å, penetration in most engineering materials is very low so that near-back-reflection has to be employed and the volume sampled is just a thin surface layer. To demonstrate and to develop this technique at a synchrotron source a peened IN718 nickel-based superalloy plate sample, that is also used as a neutron development standard, was employed. The results are illustrated in figure 1 as a graph of lattice spacing d versus $\sin^2\psi$.

The transmission technique was used to map the residual strain field in a series of laser-formed, 0.8 mm thick, aluminium sheets. A typical result from one of the series is shown in figure 2 as peak position versus depth into the sheet, x, and as transverse distance, y, from a bend in the sheet made by laser-forming. Laser-forming is a relatively new technique used to shape sheet metal. The sample had been illuminated at a laser power of 800 W, with the laser defocussed to a 10 mm diameter spot, using a pass velocity of 35 mm/sec.

The figure illustrates the strain parallel to the laser pass direction with low values of peak position indicating tensile strain. The sheet was bent about the laser pass line by the thermal contraction stresses generated as the region beneath the laser line cooled down. The tensile strains, and stresses, which are symmetrical around the line y = 0, are greatest near the point of illumination and form a gully of width around 10 mm (the diameter of the laser spot) from the top surface (xtrans = 0 mm) through to the bottom (xtrans = 0.8 mm.

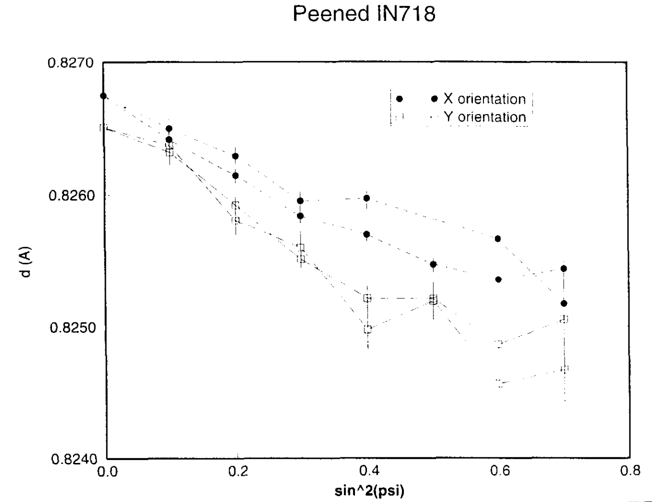

Figure 1. Lattice spacing d versus $sin^2 \psi$ for a peened IN718 plate measured in, X, and perpendicular, Y, to the machining direction

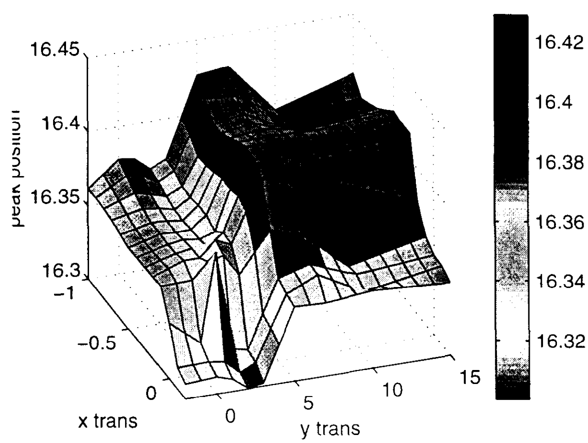

Figure 2. Peak position versus depth into the sheet, x, and as transverse distance, y, from a bend in a 0.8 mm thick aluminium sheet made by laser-forming