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INFORMATION

Neutron Program for Materials Research
Applied Neutron Diffraction for Industry (ANDI)

Near-Surface Stress Mapping

Non-destructive Measurement of Residual Stress

Materials Research
Process Evaluation
Failure Analysis
Residual Stress
Laser Ablation
Shot Peening

The Need

The stresses introduced by surface treatments such as shot peening and laser ablation, extend to several millimetres below the surface, with the greatest variations occurring within the first millimetre of the surface.

The accurate determination of residual strain by diffraction has traditionally fallen into two spatial regimes:

- surface measurements, using highly attenuated x-rays (typically 1-100 μm)
- measurements at depth, using highly penetrating neutrons (typically 1-30 mm)

A new **non-destructive** neutron diffraction technique, called *Near-Surface Stress Mapping*, has been developed to probe continuously from 0.1 mm below the surface to well inside the specimen. Labor-intensive layer removal and re-measurement is not needed.

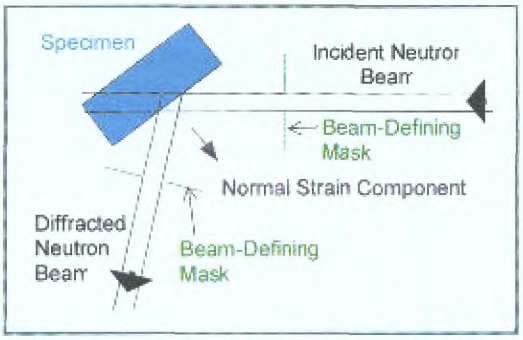

Figure 1: The normal strain component (as indicated by the arrow) is measured at the position of the intersecting beams.

The Technique

When an incident neutron beam impinges upon a crystalline specimen, neutrons are diffracted at an angle that depends on the spacing between planes of atoms, *d*. With accurate measurement of the diffraction angle, the *d*-spacing between the lattice planes can be calculated, to determine whether the planes are being pushed together (compression), or pulled apart (tension).

Neutron-absorbing masks define the incident and diffracted beams. Information about the plane spacing is obtained from the material contained within the intersection volume of the beams. The specimen is positioned with respect to the intersection volume using a suitable combination of precise, computer-controlled translations and rotations (see figure 1).

The basis of the technique is the same as standard neutron diffraction strain

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