The Early Days of Strain Measurement at UKAEA, its Development Helped by Peter Webster, and its Present and Future Potential

M T Hutchings

Department of Materials Engineering
The Open University, Milton Keynes, MK7 6AA, U.K.

The early days of strain measurement at AERE Harwell, in which the technique using neutron diffraction was first developed in the UK, will be briefly reviewed. The initial motivation was the general trend at Harwell to apply the techniques developed by UKAEA for the Nuclear Industry to general industrial problems. The relatively high depth penetration of neutrons into most materials was seen to have a big advantage. The fundamentals of the technique were developed and problems arising, mainly of a purely scientific nature, identified. Of the latter, the lattice strain response to stress in the plastic regime was a big question - and this still requires much more work today. Also a new approach to the theory of polycrystalline diffraction was required, in which the location of each part of the sample within the instrumental gauge volume giving rise to the diffraction peak becomes of importance.

Nevertheless early applications to investigate stress in samples from the Nuclear Industry were found to give important information. Pressure to extend the use of the technique to make profits from general industrial application increased as the nature of UKAEA changed towards eventual privatisation as AEA Technology. Examples of this development, including the use of other neutron sources which became essential after 1990 when the Harwell reactors were both shut down, will be given.

Alongside the UKAEA work, scientists and engineers in UK Universities began to use the technique and help in its development. These included Peter Webster at Salford, who helped establish D1A as the prime ILL instrument but who also worked on D20. Peter's practical approach to problems resulted in many advances, and while the ILL reactor was shut down he continued his work at Chalk River, Canada. Modified diffraction instruments which could be used for the technique were being made available on several neutron sources in 1990, and both Peter and I, when serving on the ILL Scientific Council, lobbied for a dedicated instrument at ILL. However at that time the priority was to renovate the reactor itself. Now, some 15 years later, we see a dedicated instrument SALSA installed near D1A, along with ENGIN-X at ISIS, and new or modified instruments dedicated to the technique at most neutron sources.

Neutron diffraction strain and stress measurement became more formally standardised for industrial use through the recent VAMAS project, in which Peter and his brother George played leading roles along with practitioners from around the world. The move to make the use of the technique more efficient, and to help enable engineers who have little knowledge of fundamental physics to readily benefit from it, has resulted in the FaME 38 facility here at ILL - set up by Peter.

Neutron diffraction strain measurement has certainly come of age, and an introductory textbook is now available [1]. However there remain outstanding many improvements still to be made, both in practical execution and in theoretical understanding.

Reference

[1] *'Introduction to the Characterization of Residual Stress by Neutron Diffraction',* M T Hutchings, P J Withers, T M Holden and T Lorentzen. Taylor and Francis, Boca Raton, 2005.