ENGINEERING NEUTRON DIFFRACTION INSTRUMENTS AT HFIR AND SNS AND THEIR APPLICATION TO STUDIES OF THE BEHAVIOR OF STRUCTURAL MATERIALS

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Abstract

Neutron scattering research has a lot to do with our everyday lives. For example, things like jets, credit cards, pocket calculators, compact and computer discs, have all been improved by neutron-scattering research. Neutrons also help researchers improve materials used as high-temperature superconductors, powerful lightweight magnets, aluminum bridge decks, hydrogen storage, fuel cells, diesel engines, and stronger plastic products. At ORNL the Department of Energy is sponsoring the High Flux Isotope Reactor (HFIR) and the Spallation Neutron Source (SNS). Together, these world leading neutron sources will dramatically change the availability of neutrons for research in North American, and both will be operated as DOE User Facilities.

The HFIR Center for Neutron Scattering is the highest flux reactor-based source of neutrons for materials research in the United States. Thermal and cold neutrons produced by the HFIR are used for research in physics, chemistry, materials science, engineering and biology. Fifteen new instruments are being installed at HFIR; those that are operational include three triple axis spectrometers for inelastic scattering studies, the mirror reflectometer, two small angle neutron scattering instruments and the residual stress mapping facility (NRSF2). NRSF2 is used for measurement of material behavior during deformation and for mapping of residual stresses throughout the thickness of components. Development, performance, and research highlights from the neutron residual stress mapping facility will be highlighted.

The SNS is an accelerator-based neutron source being built in Oak Ridge. While it has achieved the highest power level in the world for a spallation neutron source the power level is regularly being raised with a goal of being about four times greater. SNS provides the most intense pulsed neutron beams in the world for scientific and industrial research. One of the first five instruments to be available is POWGEN3 which will be an extremely flexible and versatile general-purpose diffractometer useful for a wide range of crystallographic studies. The VULCAN instrument, to be completed in the next round of instruments at SNS, will be the world's best neutron diffraction instrument for materials science and engineering studies. Design, construction progress and future research directions will be presented.

Research sponsored by the Assistant Secretary for Energy Efficiency and Renewable Energy, Vehicle Technologies Program, as part of the High Temperature Materials Laboratory User Program, Oak Ridge National Laboratory, Managed by UT-Battelle, LLC, for the U.S. Department of Energy under contract number DE-AC05-00OR22725.