1.4.32. EXPLOITATION THE POTENTIALITIES OF NEUTRON DIFFRACTION FOR NON-DESTRUCTIVE TESTING OF CONSTRUCTIVE MATERIALS

Sumin V.V., Balagurov A.M., Bokuchava G.D., Papushkin I.V.,
Joint Institute for Nuclear Research, Frank Laboratory of Neutron Physics,
Dubna, Russia

Investigations of internal stresses using high resolution neutron diffraction were introduced about 20 years ago and became widespread due to many advantages in comparison with traditional techniques: high penetration depth, high spatial resolution, separate determination of strain anisotropy and stress distribution for each phase in multiphase materials, possibility to investigate magnetic as well as non-magnetic materials, possibility to investigate irradiative materials and components.

Till now the Laboratory of Neutron Physics, JINR, Dubna, is the only scientific centre in Russia where neutron diffraction is regularly used for internal stresses studies and practical measurements. This work is conducted using high resolution Fourier diffractometers (HRFD [1] and FSD [2]) on the IBR-2 reactor. The following equipment is used for experiments: 5-axis goniometer for total strain tensor measurements, load testing machines, mirror furnace for material studies at temperatures up to 2,000°C. A minimum measured gauge volume is $2 \times 2 \times 2$ mm^3. A typical measuring time for single diffraction spectrum is 2 – 4 hours.

A number of experiments, characterizing main directions in this field of investigation were performed on HRFD and FSD. As concerns to reactor material science the following samples were studied: bimetallic joints, austenitic build-up welding on ferritic steels, weld seams. Furthermore, mechanical properties of austenitic steel at various load conditions (including cyclic load) were investigated. Residual stresses, phase contents and mechanical properties in new perspective materials – gradient structures and composites – were studied. Neutron experiment results are already used for materials technology and machinery units optimisation [3, 4].

References:

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