

NEUTRON DIFFRACTION MEASUREMENTS OF RESIDUAL STRESS IN WELDS FABRICATED FROM HIGHLY ANISOTROPIC MATERIALS

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Neutron diffraction measurements have been made of the stresses in welds fabricated from Zircaloy, beryllium, titanium and uranium over the past couple of decades. These materials display easy and hard slip directions, and therefore are plastically anisotropic, elastic anisotropy and, in three of the above cases, coefficients of expansion which vary with the crystallographic direction. The plastic anisotropy often leads, through the manufacturing route, to strong texture in the parts to be joined but melting and consequent solidification then generate texture gradients through the weld. Melting may also cause gradients of lattice parameter of a chemical nature. The anisotropy of thermal expansion upon cooling always leads to thermal intergranular stresses upon which the weld stresses are superposed. The experiments must avoid the artifacts associated with texture or chemistry gradients and must take account of the intergranular effects. Examples of stress analysis, with various degrees of assurance, are presented which are drawn from neutron diffraction experiments on the above materials. The stresses associated with welding are usually found to be conventional in form even though the materials are anisotropic.