DIFFRACTION STRESS MEASUREMENT ON COARSE GRAINED MATERIALS

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The present paper deals with the measurement of residual stresses in cast materials and/or a heat affected zone in welding part. The crystal grains in these parts grow in size due to the thermal history suffered in a sequence of process. In the case of stress measurement by X-ray or neutron diffraction, lattice strains in a group of crystals are measured by diffraction. In the $\sin^2\psi$ method of X-ray stress measurement, the diffraction intensity must be observed in any orientation in a plane containing the surface normal and the direction in which the stress will be evaluated. Neutron stress measurement normally necessitates three principal strains. These conditions are satisfied when a grain size is small enough with comparing to the X-ray or neutron irradiation volume.

In cases of cast materials and/or a heat-affected zone in a welding part, the grain size will be too large not to obtain diffraction intensities in an arbitrary orientation. An oscillation method intending to get diffraction in an objective orientation is a successful method in the case where the grain size is not so large. However, a more growth in size of crystals gives difficulties in observing diffraction intensities even by the oscillation method. The method proposed in this paper uses a rocking curve measurement. The strains measured in the orientations where the diffraction is observed in the rocking curve are applied to estimate principal strains. These strains are followed by the evaluation of stress components. The generalized method is explained and the experimental results on a coarse grained aluminum cast specimen are described.