FLOW STRESS ANALYSIS OF HADFIELD STEEL AT HIGH STRAIN RATE

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The flow stress of Hadfield steel is affected by dynamic strain ageing (DSA), mechanical twinning, and forest hardening contributed by dislocation accumulations. In this study, austenitic Hadfield steel was tensile tested at a strain rate of 10^{o} s^{-1}, and the twins characteristics and dislocation densities were estimated quantitatively at different strain levels. DSA was suppressed as a result of performing the tensile testing under high strain rate, so that its effect on the flow stress was neglected. The deformation twins were studied by the transmission electron microscopy. In addition, dislocation densities were estimated by analysing the X-ray diffraction patterns using Rietveld analyses carried out by the MAUD programme. It was found that during the initial stages of deformation, the mechanical twinning was more effective than the forest hardening because of the nucleation of twin boundaries. However, with increasing strain, the thicknesses of the twinned plates were increased, resulting in reduced contributions by the mechanical twinning to the flow stress of the Hadfield steel. Nevertheless, increasing of dislocation densities with increasing strain resulted in enhanced contributions by forest hardening to the flow stress.