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 $10^6$ s\textsuperscript{-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.