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MICROSTRUCTURE AND TEXTURE STUDY OF HIGH TEMPERATURE UPSET FORGED 304LN STAINLESS STEEL

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ABSTRACT

The austenitic group of stainless steel is an important group of material for nuclear, petro-chemical and fertilizer industries. These steels havehigh corrosion resistance and great strength at high temperatures which make it favorable for these severe environments. Usually produced through thermo-mechanical processes, these single phase steels undergo microstructural changes which largely influence their final properties. These microstructural changes are described byrecovery, recrystallization and grain growth which are mainly controlled by the process parameters *viz.* strain, strain rate and temperature. For 304 austenitic stainless steel, which is a low static fault energy (SFE) material the microstructural changes during deformation are controlled by recrystallization rather than recovery and is described by discontinuous dynamic-recrystallization (dDRX). Because of its importance, a good number of research works has been reported for the hot deformation behavior of this material which are carried out through laboratory-scale compression tests in the strain rate range of 0.001-10 s^{-1}. In the present work, 304LN austenitic stainlesssteel has been forged, i.e.uniaxially compressed, in the temperature range of 900°C to1200°C at a strain rate of 100 s^{-1}. Gleeble 3800 system has been used for this purpose. Samples were heated (at the rate of 5 °C/s) to various required test temperatures (900 °C, 1000 °C, 1100 °C and 1200°C) and held at a particular temperature for 5 minutes for uniform heating. Compressive load was then applied along the longitudinal direction of the samples to deform them to a true strain of ~ 0.4. Samples were then rapidly cooled to room temperature in order to retain the deformed microstructure for further study. The deformed samples have been characterized through electron back scattered diffraction (EBSD). A recrystallized microstructure was observed at all the deformation temperatures except 900 °C. Traces of δ ferrite formation have been observed for all the above mentioned temperatures. Development of annealing twins in the temperature range of 1000 °Cto1200°C leads to random texture formation for the austenitic phase. On the other hand, the δ ferrite formed is having orientation [101] || to the deformation axis. Development of δ ferrite in austenitic stainless steel during high-temperature deformation at a high strain rate has been reported earlier. This can be noted that in addition to deformation at high temperature and high strain rate, the composition of the 304 austenitic stainless steel also plays an important role in the formation of δ ferrite. The transformation of austenite to ferrite is enhanced by the dislocation interaction leading to an increase in dislocation density which is believed to facilitate the transformation. This transformation is observed in the region of intense shear. A further detailed investigation is required to study the formation of δ ferrite.

Keywords: Microstructure, Texture, EBSD, Steel, δ ferrite

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