austenite grain control was shown by steel with contents of Ti=0.044, Al=0.009, N=0.0131 (mass%) and a Ti/N ratio of 3.36. But the interpolation of the results allows it to be concluded that the best Ti/N ratio would be close to 2.5. It was also found that the control of austenite grain size improved with an addition of Nb. In paralell, a study of precipitate sizes was carried out using transmission electron microscopy (TEM) and scanning electron microscopy (SEM).

(cf. *ISIJ Int.*, **42** (2002), 1288)

Morphology of sulfide formed in the Fe–Cr–S ternary alloys

H.MITSUI et al.

The evolution of sulfide morphology in the Fe–(0.3–18)mass%Cr–(0.05–0.3)mass%S alloys during solidification and heat treatment was investigated by means of optical microscopy, scanning electron microscopy, analytical electron microscopy and X-ray diffraction. *In situ* observation of the formation of the fine particle sulfide was also conducted at elevated temperatures by confocal scanning laser microscopy. The morphology of sulfide in the Fe–Cr–S ternary alloys was found to change from a cell wall type to a globular type with increasing Cr content. Accompanying the phase transformation of the matrix from the δ phase to the γ phase, two types of transgranular fine particle sulfide were formed. One is a fine spherical sulfide formed from the FeS-rich liquid phase through the remelting reaction of $\delta \rightarrow \gamma$+Liq. in less than 5 mass% Cr alloys, and the other is a fine rod-like sulfide formed through the eutectoid reaction of $\delta \rightarrow \gamma$+sulfide in 5 to 13 mass% Cr alloys. The formation mechanism of various types of sulfide morphology was examined based on phase diagram information.

(cf. *ISIJ Int.*, **42** (2002), 1297)

Mechanical Properties

Fracture surfaces and mechanical properties in ductile iron

V.M.BERMONT et al.

This work focuses on qualitative and quantitative studies about the fracture surface topography of ductile cast iron samples having different matrices and sizes.

Parameters such as: a) surface roughness, b) actual fracture surface and c) actual nodule count on fracture surface were defined and calculated for fracture surfaces of several experimental test samples. These parameters were related to the values of mechanical properties measured on the same samples, and empirical expressions were established. These expressions, together with data taken from the fracture surface of a broken part, could allow to estimate the critical level of stress and deformation which acted on the part.

(cf. *ISIJ Int.*, **42** (2002), 1303)

Creep behavior at the intercritical HAZ of a 1.25Cr–0.5Mo steel

S.FUJIBAYASHI et al.

Nowadays the preferential creep damage accumulation at the Intercritical HAZ (ICZ) leading to Type IV cracking has been a great concern for various industries. The ultimate failure of the welded components fabricated from ferritic steels often takes place at this particular region. Type IV cracking has been found in almost all the ferritic steel weldments so far, from a conventional 1.25Cr–0.5Mo steel to a modified 9Cr–1Mo steel. However, the mechanism of Type IV cracking has not yet been understood equivocally. In the present work, cross-weld creep behavior of a service exposed 1.25Cr–0.5Mo steel has been examined in order to clear the feature of Type IV damage. The discussion shall be made on the important role of grain boundaries around small grains, which was transformed into austenite during welding, to promote Type IV cracking. The evident feature of grain boundary facets suggests strongly that Type IV cracking is induced by the grain boundary sliding around small grains. Significant impurity segregation, which is expected to accelerate the damage development by stabilizing cavities, was found at grain boundaries.

(cf. *ISIJ Int.*, **42** (2002), 1309)