Beaudier, Cabane and Mouturat³. In C_1 the α was equiaxed and the grain size decreased with temperature of formation; in C_2 the α had a fine acicular structure.

It follows from this work that the β -phase can transform to α by three mechanisms. In C_1 the insoluble chromium is precipitated, showing that long-range diffusion is involved. Electron microscope evidence indicates that this is a eutectoid type process⁹. C_3 is clearly martensitic⁴⁻⁷. However, the evidence relating to C_2 is scant. Dixon and Burke suggested that this curve corresponded to a reaction in which supersaturated α is formed by shear of the β and the insoluble chromium is simultaneously rejected from the α lattice in the form of a fine precipitate. However, it can be seen by comparison of Fig. 1 with the TTT diagram of Dixon and Burke that increasing the chromium content from 0.5 to 0.85 per cent depresses C_3 much more than C_2 and produces a marked separation between the C_2 and C_3 . It is therefore arguable that the closer proximity of the two upper C -curves indicates that the mechanism in C_2 is more akin to the known diffusional reaction in C_1 than to the martensitic reaction in C_3 . This would suggest that the phase change in C_2 involves diffusion as the predominant process.

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R. D. TOWNSEND
J. BURKE

Department of Metallurgy,
University of Liverpool.

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Precipitation of Vanadium Carbide on Stacking Faults

THE precipitation of niobium carbide and titanium carbide in association with stacking faults in austenitic steels has been widely reported in the literature¹⁻⁴. During the course of an examination of precipitation in high-alloy austenitic steels we have observed the precipitation of the vanadium carbide, V_4C_3 , also in association with stacking faults.

The austenitic steel (25 per cent Ni, 20 per cent Cr, 5 per cent V, 2 per cent Si, and 0.15 per cent C) was solution treated at 1,200° C, water quenched and aged in the range 650° C–850° C. During the early stages of ageing, V_4C_3 precipitated in association with stacking faults (Figs. 1 and 2). The precipitation phenomenon could be examined by both thin foil (Fig. 1) and carbon extraction replica (Fig. 2) techniques. The precipitation of V_4C_3 in association with stacking faults brought about a substantial increase (~ 50 Vicker's pyramid number) in the hardness of the alloy. On further tempering the V_4C_3 precipitates were replaced by σ phase, with a further increase in hardness of the alloy.

Details of the investigation will be given in a future publication. We would, however, like to point out some differences between our investigation and that of earlier work on the precipitation of NbC and TiC.

(1) In niobium- and titanium-containing alloys a solution temperature of 1,300°–1,350° C was necessary to induce this type of precipitation. In our work a solution temperature of 1,200° C was quite sufficient.

Fig. 1. Austenitic steel aged 17 h at 800° C (thin foil; $\times 20,000$)

Fig. 2. Austenitic steel aged 50 h at 750° C (carbon extraction replica; $\times 50,000$)

(2) The range of temperature (650°–850° C) over which the carbide precipitated in association with stacking faults was much wider than that for niobium- and titanium-containing alloys.

(3) From the earliest stages of ageing the V_4C_3 particles were much coarser (~ 80 – 120 Å) than the niobium carbide and titanium carbide particles (~ 50 Å) reported in previous work. This is in agreement with the proposed mechanism of stacking fault precipitation⁴.

(4) At no stage (including the shortest periods at 650° C) were stacking fault 'fringes' observed in thin foils.

J. J. IRANI

R. T. WEINER

British Iron and Steel Research Association,
Hoyle Street, Sheffield 3.

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