

The Characterization of an Alloy 600 after Heat Treatments

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1. INTRODUCTION

Alloy 600 is an austenitic nickel-base alloy containing chromium and iron which has been used in applications with a combination of excellent mechanical properties and corrosion resistance (Donachie, 1984; Sims, 1972; Kai et al, 1989). Attempts have been made to modify the microstructure of alloy 600 to improve these conditions. The microstructure has been modified principally by a thermal treatment in the carbide precipitation temperature range that benefits considerably the corrosion resistance. In this work, we present some microstructural aspects by TEM (200 kV) of the alloy 600 after heat treatment.

2. EXPERIMENTAL PROCEDURES

The material used for the investigation was an alloy 600 that initially 90% cold rolled and then solubilized at $T = 1150\text{ }^{\circ}\text{C}$ for 15 minutes in vacuum and quenched in water. After this, the material was heat treated at 620, 720 and 820 $^{\circ}\text{C}$ for 1, 10 and 100 h in an inert atmosphere. The characterization was made in a 200 kV transmission electron microscope (JEM-200C) and the thin foils was obtained in a twin jet equipment using a 10% perchloric acid in methanol solution. The precipitate identification was made by electron diffraction pattern in a selected area and also with EDS microanalysis in a JEM-2000FXII (MPI/STUTT GART/FRG).

3. RESULTS AND CONCLUSIONS

The TEM observations show a precipitation preferably at the grain boundaries on the microstructure of the alloy with increasing time of the heat treatment (Figure 1). The observed precipitates were identified as Cr_{23}C_6 and Cr_7C_3 (Figure 2) and also a small presence of iron and nickel carbide. This corroborate the remaining ductility in this alloy after a large time of heat treatment because chromium carbide is a "soft" precipitate.

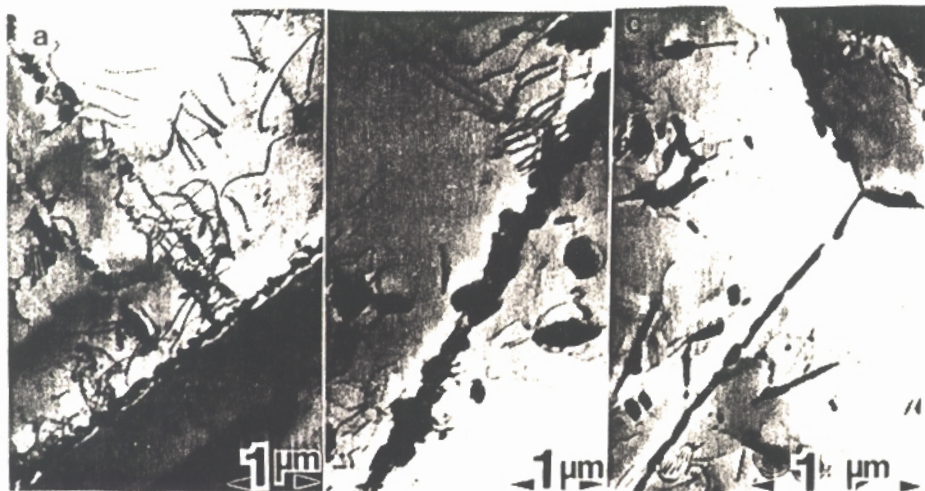


Figure1. Precipitation principally in the grain boundary , but also in interior of the grains . Electron micrographs of an alloy 600 heat treated at : a) 800 °C for 1h ; b) 720 °C for 10 h ; c) 720 °C for 100h .

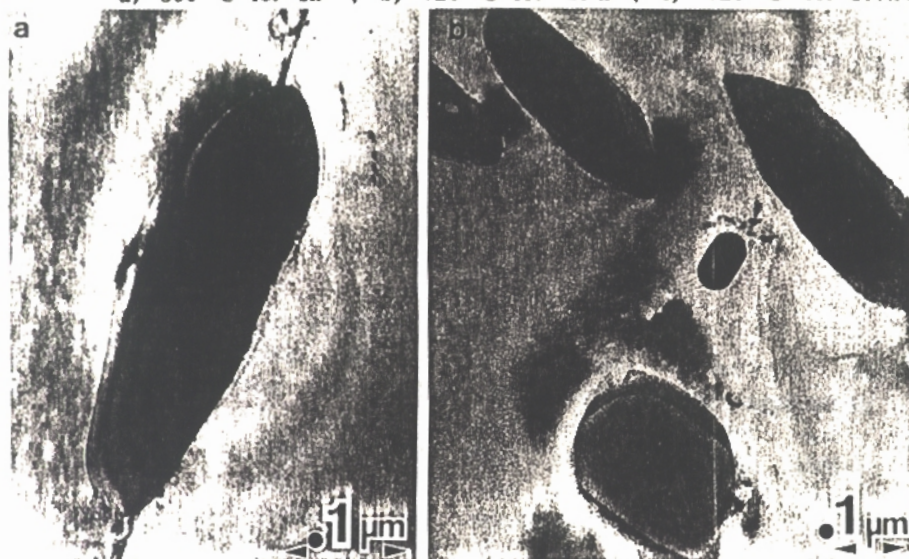


Figure 2. Electron micrographs of carbide precipitates in an alloy 600 heat treated at 720 °C for 100h (EDS microanalysis in TEM) : a)Chromium-rich carbide precipitate in a grain boundary ; b) Chromium (A) and nickel (B) -rich carbide precipitate in the interior of the grain

Donachie,M.J.;Superalloys Source Book, ASM , (1984) .

Kai,J.J.; Tsai,C.H.;Huang,T.A. and Liu,M.N. ,Met. Trans A ,vol. 20A,(1989) ,1077-1088 .

Sims,C.T. and hagel,W.C. , The Superalloys , Willey ,N.Y. (1972)