MASTER

PRECIPITATION REACTIONS IN A BERYLLIUM-BEARING STAINLESS STEEL

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Precipitation reactions in a beryllium-bearing stainless steel alloy have been studied by TEM and electron diffraction for ageing temperatures between 400° and 900°C. The nominal composition of the alloy was 38% Ni - 21% Cr - 1% Mn - 0.5% Be - Bal Fe. Specimens were solutionized for one hour at 1150°C and water quenched. The ageing reaction was studied by hardness measurements for times between 0.5 and 16 hours. The TEM specimens discussed herein were made from samples aged one hour.

The ageing reactions in this alloy were similar to those reported for Cu-Be¹, Ni-Be², and Fe-Ni-Be³, except that no evidence of cellular precipitation was observed.

Prior to ageing, the alloy was found to be single-phase FCC austenite with $a_0 = 3.58\text{\AA}$. The precipitation at 400 and 500°C was characterized by G-P zones formed on austenite (100)_γ planes (Fig. 1). At 600°C to 800°C, a semi-coherent disc-like precipitate was observed. This precipitate was determined to be an ordered body-centered tetragonal phase (β') based on NiBe (Fig. 2). The habit plane was (100)_γ. The lattice parameters and orientation relationship with the matrix were determined to be:

$$\begin{aligned} a &= 2.53 \text{ \AA} \\ c/a &= 1.06 \\ (001)_{\gamma} \parallel (001)_{\beta'} \\ [100]_{\gamma} \parallel [110]_{\beta'} \end{aligned}$$

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Ageing at 900°C for one hour produced the structure shown in Figure 3. The habit plane of these coarsened coherent precipitates was found to be $(113)_\gamma$. A similar coarsening reaction in Ni -2% Be has been reported by Hills and Nordstrom.²

The structure of solutionized, rolled (~90%), and aged (800°C) material is shown in Figure 4. Recrystallization occurred under these conditions, producing a coarse dispersion of incoherent globular particles of $\text{NiBe}_{(\beta)}$ in fine grained austenite.

Also observed in samples aged at and above 500°C were coherent M_{23}C_6 carbides precipitated at grain boundaries and on dislocations. The alloy contained 0.055 wt%C as an unintentional alloying addition.

This work was supported by _____

1. W. Bonfield and B. C. Edwards, J. Mat. Sci., 9, 1974, p. 398
2. C. R. Hills and T. V. Nordstrom, Proc. 35th EMSA Meeting (1977) p. 268
3. J. C. Mazaud and A. Vial, Acta Met. 19 (1971) p. 1133

FIGURE 1: GP ZONES formed after 1 hour at 500°C (25000X)

FIGURE 2: Precipitates formed after 1 hour at 700°C (85,000X)

FIGURE 3: COARSENEO PRECIPITATE FORMED
AFTER 1 hour at 700°C.

FIGURE 4: INCOHERENT, GLOBULAR Ni_3Be FORMED
~~AFTER~~ BY AGING BALL-BEARING MATERIAL 1 hour
AT 800°C (8000X)