DIFFUSION INDUCED RECRYSTALLIZATION OF NI_3AL-BASED ALLOYS

N.I. AFANASYEV, O.K. LEPAKOVA

Tomsk Scientific Center SB RAS, 10/4 Akademicheskii Pr., 634055, Tomsk, Russia, af42@yandex.ru, +7(3822)492294

Ni_3Al-based alloys exhibit an abnormal temperature dependence of yield stress and high heat resistance, which allow us to consider these alloys to be promising heat-resistant materials. To increase the creep resistance, the intermetallide Ni_3Al was doped with chromium and carbon.

The evolution of the phase composition and substructure during diffusion induced recrystallization (DIR) was studied using a micro-analyzer (Camebax microbeam), and the Neofot-21 optical and JEM-F200 electron microscopes.

After SH-synthesis and annealing at 1473 K for 4 hours, the alloy has an aggregate structure consisting of equiaxial Ni_3Al grains with a size of ~50 μm and Cr_7C_3 particles with a volume fraction of ~1.6% located along the large-angle grain boundaries (Fig. 1a). The small-angle boundaries are free of particles. Annealing at 1573 K leads to the dissolution of carbides and the development of DIR. DIR forms a structure (Fig. 1b, c) that is morphologically similar to the structure of supersaturated solid solutions after cellular decay. In contrast to ordinary cellular decay, the increased concentration of the doping element (chromium) is observed in the regions undergoing the transformation, not in the initial matrix.

A structure consisting of γ' phase cubic-shaped grains 0.2-0.3 μm in size is formed in cells. Thin layers of the disordered γ phase are observed in cells (Fig. 1c). The initial grain boundaries do not move during the growth of cells. The reaction front has a diffuse dislocation structure (Fig. 1c), which indicates a high voltage in the reaction front.

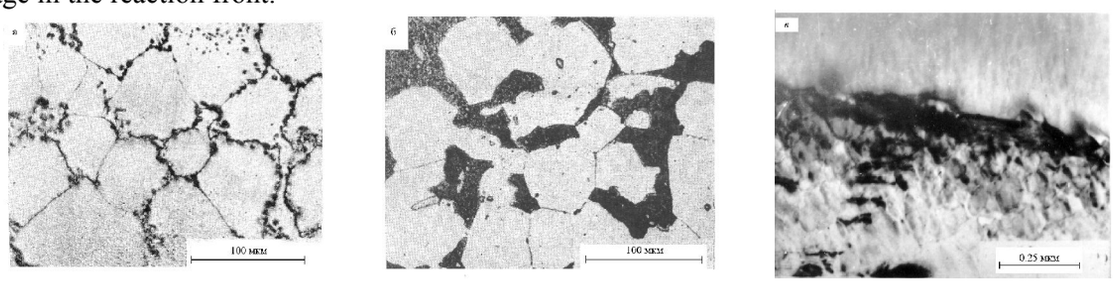

Fig. 1. Structure of the Ni_3Al alloy in the initial state (a) and after DIR (b, c).

Dispersion of Ni_3Al grains near the boundary area is caused by the saturation of matrix with chromium, which leads to a decrease in the temperature during the disordering of intermetallides. Figure 2 shows the creep curves of the alloy.

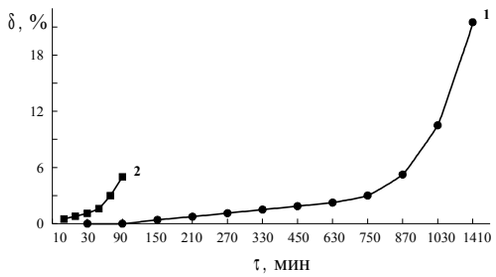

Fig. 2. Creep curves of the Ni_3Al alloy at 1473 K in the initial state (1) and after DIR (2).

DIR leads to a sharp decrease in the creep resistance of the alloy (Fig. 2).