

§15. Annealing Effects on Mechanical Properties and Microstructure for Oxide Dispersion Strengthened (ODS) Steel as Fusion Blanket Structural Materials

Li, Y.F., Nagasaka, T., Muroga, T.

Introduction

Oxide dispersion strengthened (ODS) steels are the promising fusion blanket structural materials for use up to about 650- 700°C because of the excellent creep strength relative to Reduced Activation Ferritic/martensitic steels (RAFM).^{1,2)} It is very important to understand the fundamental stability behavior during different heat treatments for the ODS steels.

Experimental

The material used is the 9Cr-ODS steel with a chemical compositions of Fe-9.08wt%Cr-1.97%W-0.14C%-0.29%Y-0.23Ti%. The steel was normalized at 1050°C for 1 hour and then tempered at 980°C for 1 hour.

The annealing experiments were carried out from 700 to 1150°C for 1 hour with a step of 50°C to understand the thermal stability fundamentally. After annealing, hardness was measured with a loading of 300 g for 30 s. Microstructure was also observed by scanning electron microscope (SEM).

Results

The hardness results are shown in Fig.1. Heat treatment below 900°C for 1 h did not change the hardness, indicating the stability of microstructure. On the contrary, the hardness was increased significantly at temperature over 900°C, suggesting the phase transformation.

Figure 2 shows the microstructure at normalization and tempering (N&T) condition and after annealing observed by SEM. As shown in Fig. 2(a), the 9Cr-ODS steel exhibits a tempered martensitic structure decorated with the carbides and fine dispersed nano-particles. The size of grains and particles were almost no change after annealing from 700 to 900°C. On the contrary, phase changed from martensite to austenite above ~950°C. This is agreed to the results of hardness measurement.

Conclusion:

The 9Cr-ODS was annealed from 700 to 1150°C for 1 hour. After annealing, the hardness and microstructure did not change when temperature below ~900 °C , suggesting stability. While above ~900°C, the hardness increased and phase changed from martensite to austenite.

- 1) Ukai, S. et al.: ISIJ International **43** (2003) 2038.
- 2) Li, Y.F., et al.: Fusion Eng. Des. **86** (2011) 2495.

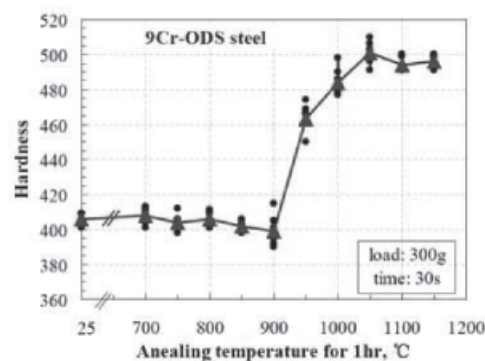


Fig.1 Dependence of hardness on annealing temperature for 9Cr-ODS

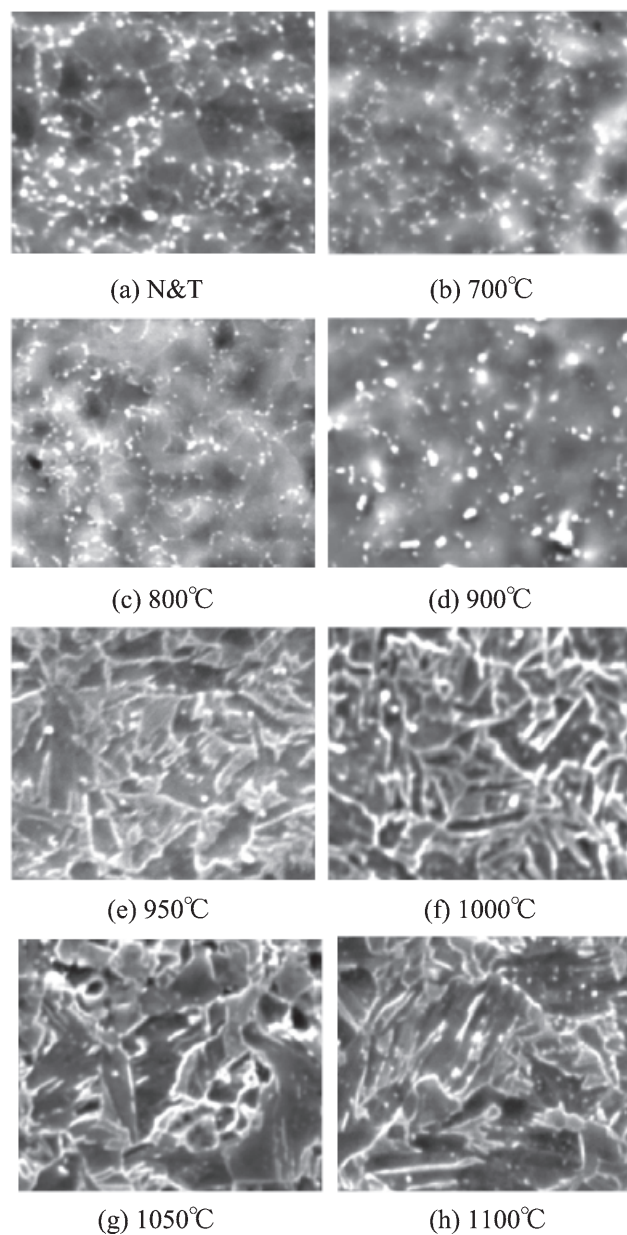


Fig.2 Microstructures by SEM at normalization and tempering (N&T) and annealing conditions from 700 to 1100°C.