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 (RAFMs). 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.