§19. The Effects of Ion Irradiation on Heat Affected Interface between W and Low Activation Structural Materials

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1. Introduction

Recently, the development and fundamental properties of W sprayed low activation alloys (F82H and V-4Cr-4Ti alloy) are studies by NIFS and universities. In the case of V-4Cr-4Ti, susceptibility of the alloy to the embrittlement caused by interstitial impurities during the procedure is highly pronounced. From our welded V-4Cr-4Ti alloy, radiation enhanced formation of Ti(CON) precipitates with {100} habit planes were homogenously formed in the heat affected regions. And radiation induced hardening of the alloy is strongly enhanced by these small precipitates. In the present paper, to investigate the effect of irradiation on the materials, the microstructure of before and after the head load of W brazed and VPS-W on V-4Cr-4Ti alloys were studied by SEM and TEM.

2. Results[1-2)]

1mm-thick sintered pure W was brazed with annealed NIFS-HEST-2 substrate using 0.025 mm Fe-3B-5Si foil. The brazing condition was 1453K for 30 min in a vacuum of about 1.0 x 10^{-3}Pa. Fig. 1 shows SEM images of the interface between NIFS-HEAT-2 and brazed W. In the brazed sample, about 30 μm of intermediated layer was observed at the interface. For the transmission electron microscopy, the interface was prepared by Focus Ion Beam Technology (FIB). Fig. 2 shows the TEM images of interface between NIFS-HEAT-2 and brazed W. In the figure, (a) and (b) show microstructure near NIFS-HEAT-2 side and brazed W side, respectively. As shown in Fig. 2(a), in NIFS-HEAT-2 side, grown of grain perpendicular to the interface, which is commonly observed in welded sample was prominent. And blocky Ti precipitates, which are observed in the NIFS-HEAT-2, are not detected. It is known that irradiation hardening of V-4Cr-4Ti alloy was mainly controlled by a very high density of dislocation loops at lower temperature, but higher irradiation temperature, formation of radiation-induced Ti(CON) precipitates becomes dominant. These results mean that the oxygen atoms, which dissolved from the large Ti(CON) precipitates during W deposition strongly affects microstructural evolution of the materials. The understanding the effect of heat treatment (namely, post-coating heat treatment; PCHT) on W coated materials is important to reduce the radiation hardening of the materials.

To know the effects of heat load, the samples were heat loaded in ACT. Fig. 3 shows surface morphology of VPS-W on NIFS-HEAT-2 before and after the heat load of about 5MW/m^2 (～50cyles). In the figure, the results of VPS-W on pure V are also shown for comparison. Before the heat load, many spherical particles, which have not melted perfectly during the plasma spray process, exist on the surface. After the heat load, the surface of VPS-W has very fine rough structure and prominent crack due to thermal heat load was not detected. Samples for ion irradiation are preparing from VPS-W and also brazed W.

1) T. Tokunaga, H. Watanabe, T. Nagasaka, R. Kasada, N. Yoshida, M. Tokitani, M, Mistuhara, H. Nakashima, T. Takabatake, N. Kuroki, S. Masuzaki, K. Ezato, S. SuzukiI, M. Akiba,, presented at ICFRM 15.
2) H. Watanabe, T. Tokunaga, N. Yoshida, T. Nagasaka, T. Muroga, R, Kasada, A. Kimura· presented at ICFRM15.

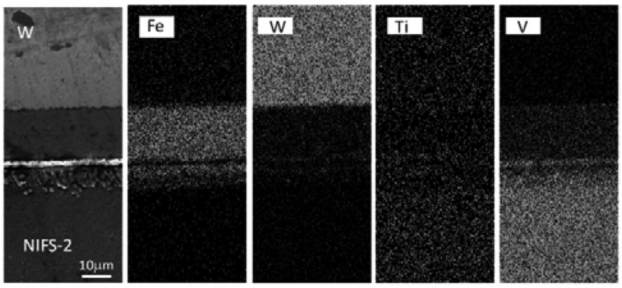

Fig.1. SEM images of interface between NIFS- HEAT-2 and brazed W.

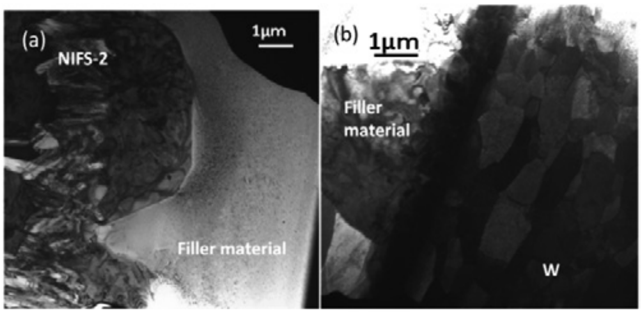

Fig.2. Microstructure of the interface between NIFS-HEAT-2 and brazed W (a) NIFS-HEAT-2 side (b) W-side

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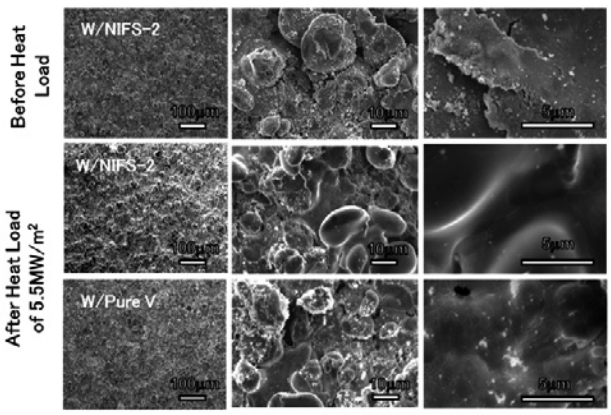

Fig.3. SEM images showing surface morphology of VPS-W on NIFS- HEAT-2. In the figure, VPS-W on pure V is also shown for comparison.