§22. The Microstructure of W Sprayed Low Activation Structural Materials

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1. Introduction

Recently, the fundamental properties of W sprayed low activation alloys (F82H and V-4Cr-4Ti alloy) are studied by NIFS and universities. One of difficulties of the VPS coating of W on F82H plates is that the temperature of F82H substrate must be kept below its tempering temperature, 1020 K, during the coating process to keep its good mechanical properties. It is likely that very rapid cool down of the melted W particles after deposition on the surface leads to poor bonding at the interface due to the defects introduced by the thermal shrinkage stress. Therefore, influence of substrate temperature and size of W powder on the various properties, such as thermal conductivity, mass density, macroscopic and microscopic structure, mechanical properties, heat load resistance and vacuum properties, of the coated W were examined to develop high-grade W coating on the low activation materials.[1)]

In the case of NISF-HEAT-2, on the other hand, susceptibility of the alloy to the embrittlement caused by interstitial impurities during the procedure is highly concerned. From our laser 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, the microstructure before and after the head load from W spray and W brazing for V-4Cr-4Ti alloys were studies.

2. Results

Fig. 1 shows SEM images of the interface between NIFS-HEAT-2 and VPS-W. Before and after the heat load of about 5MW/m^2 (~50cyles), the interface was prepared by Focus Ion Beam Technology (FIB) for microscopy. Figs. 2 and 3 show the TEM images of interface between NIFS-HEAT-2 and VPS-W. Fig 2 shows the W side and fig. 3 shows NIFS-HEAT-2 side, respectively. As shown in the fig. 2, relatively large voids were formed close to the interface. And blocky Ti precipitates, which are commonly observed in the NIFS-HEAT-2, are not detected (see fig. 3). 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 on W sprayed materials is important to reduce the radiation hardening of the materials.[2)]

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

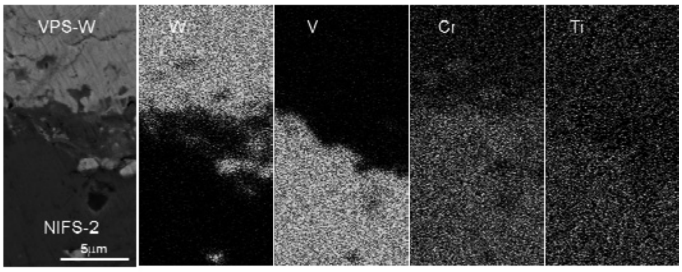

Fig.1. SEM images of interface between NIFS- HEAT-2 and VPS-W.

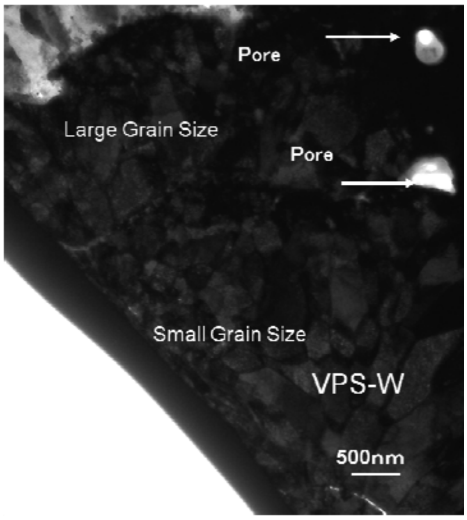

Fig.2. Microstructure of the interface (W-side).

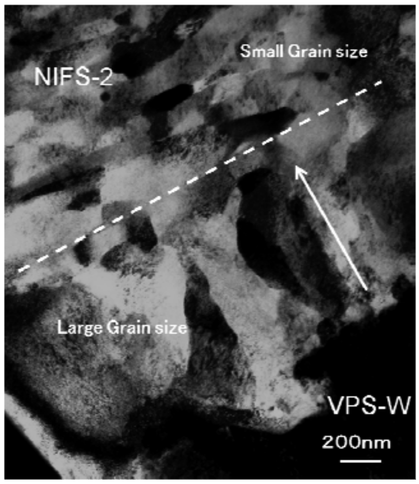

Fig.3. Microstructure of the interface (NIFS-HEAT-2-side)