§7. The Characteristics and Stability of In-situ Erbium Oxide Coating on Vanadium Alloy

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One of the critical issues for the self-cooled Li/V-alloy blanket is the magneto-hydrodynamic (MHD) pressure drop. The insulating coatings on the inner wall of components for mitigating the pressure drop are under development. The in-situ formation of coating in liquid Li is very attractive. The previous study [1] showed preliminary exploration on in-situ formation of Er$_2$O$_3$ coating by exposing V-4Cr-4Ti in liquid Li doped with Er at high temperature. In this report, the results on the character and stability of the coating were shown.

V-4Cr-4Ti sheets were oxidized in flowing argon, annealed in vacuum and exposed in liquid Li doped with Er. The analyses on exposed specimen were carried out by SEM, XPS and XRD. The procedures in details were shown in literature [1].

Fig. 1 shows SEM image of V-4Cr-4Ti oxidized for 6h at 973K, annealed for 16h at 973K and exposed in liquid Li doped with Er for 100h at 973K. It showed that the surface layer with thickness of ~2μm on V-4Cr-4Ti consists of double sub-layers, namely a coating and an intermediate layer. The cracking occurred in the coating but not in the intermediate layer. Peeling happened at some places of coating.

Fig. 2 shows depth profile of elements obtained by XPS under Ar ion bombardment at a V-4Cr-4Ti surface oxidized for 6h at 973K, annealed for 16h at 973K and exposed to liquid Li doped with Er for 750h at 873K. It indicates that an Er-O coating, which is V-free and short of N, is formed on the surface of V-4Cr-4Ti. The coating was stable during exposure of 750h to liquid Li doped with Er.

Fig. 3 shows a XRD spectrum of V-4Cr-4Ti oxidized for 6h at 973K, annealed for 16h at 973K and exposed to liquid Li doped with Er for 300h at 873K. It shows Er$_2$O$_3$ and ErN peaks that were thought from the surface layer.

Results shown in Figs. 1, 2 and 3 indicates that the top layer acting as insulating coating is dominated by Er$_2$O$_3$, and that intermediate layer consists of ErN mixing with V-compounds.

The study has demonstrated that the coating is stable during exposure of 750h to liquid Li doped with Er.

Fig. 1 SEM image of surface layer on V-4Cr-4Ti

Fig. 2 Depth profile of elements in V-4Cr-4Ti by XPS

Fig. 3 XRD spectrum of V-4Cr-4Ti with layer

Reference