§41. Analysis of the Microstructure in the Heavy Ion Irradiated Oxide Thin Coating for the Liquid Blanket

Matsuda, K. (Univ. Toyama), Hishinuma, Y.

In the breeding blanket system, there are three kinds of tritium breeding methods, which are Solid, liquid metal lithium and fluoride molten salts. The MHD pressure drop is a critical issue for liquid metal breeding blanket systems. Er_2O_3 was selected as one of the best candidate materials for insulating coating because of high compatibility with liquid Li and high electrical resistivity. Recently, Hishinuma et al. succeeded to form Er_2O_3 thin coating via the Metal Organic Chemical Vapor Deposition (MOCVD) process as a new coating technology for broad and complicated shaped areas for the advanced breeding blanket applications[1,2]. MOCVD process is a vapor phase epitaxy growth which is synthesized via vapor phase from metal organic complex, and is very easy technique to form homogeneous coating layer on the broad and complex shaped area.

In this study, we investigated that surface morphology and microstructure before and after gamma-ray irradiation test of the Er_2O_3 coating which formed on Stainless steel 316 (SUS316) substrate using MOCVD process. Er_2O_3/SUS316 sample has been fabricated by MOCVD method. The thickness of Er_2O_3 layer was 800 nm, and SUS316 substrate was 1 mm. The ^{60}Co gamma-ray was irradiated for this sample surface at 500℃ for 1 hr. The morphology of Er_2O_3/SUS316 samples surface before and after gamma-ray irradiation test was observed by Scanning Electron Microscope (SEM). Then, thin samples for Transition Electron Microscope (TEM) observation were prepared by Focus Ion Beam method. TEM was operated at 200 kV (Topcon-002B).

Fig.1 shows SEM images obtained for the Er_2O_3/SUS316 sample surface before and after gamma-ray irradiation test. The Er_2O_3/SUS316 sample surface before gamma-ray irradiation has crystal grains of 1 μm in diameter, and these grains became bigger after irradiation.

Fig. 2 shows TEM images obtained for the Er_2O_3/SUS316 sample after gamma-ray irradiation test. The incident beam direction was [011] of Er_2O_3. According to index of the selected electron diffraction pattern, the growth direction of Er_2O_3 was [011]. The column width of Er_2O_3 in the sample before and after gamma-ray irradiation was compared in fig. 3, and those mean width was changed from 0.26 to 0.54 μm.

1) Y. Hishinuma et al., J. Nucl. Mater., **417**, 1214 (2011)
2) Y. Hishinuma et al. Fusion Eng. Des., **86**, 2530 (2011)

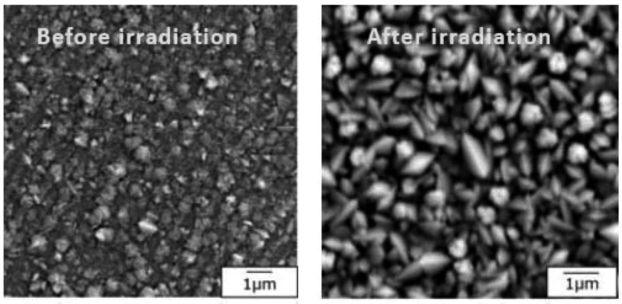

Fig.1 Typical SEM images of the surface region in the MOCVD processed Er_2O_3/SUS coating before and after gamma-ray irradiation under 500℃

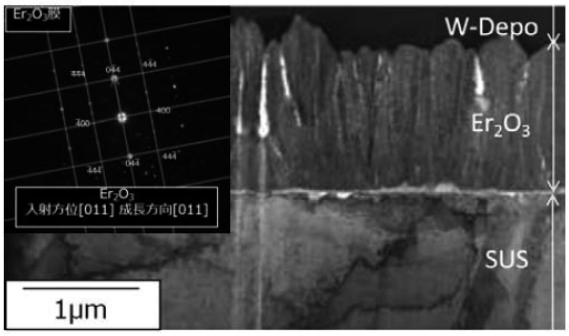

Fig.2 Typical TEM image and diffraction pattern of the MOCVD processed Er_2O_3/SUS coating after gamma-ray irradiation under 500℃

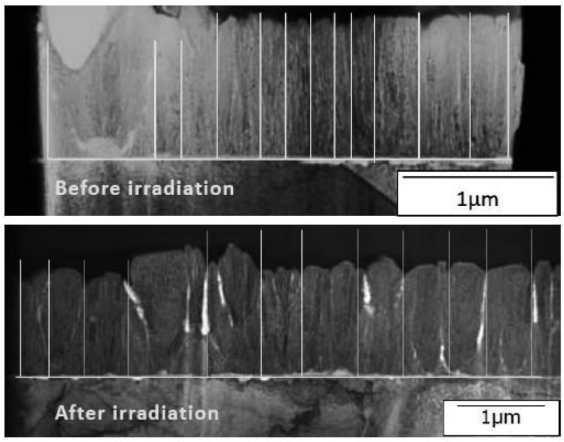

Fig.3 The column width of the MOCVD processed Er_2O_3/SUS coating after gamma-ray irradiation under 500℃