§30. Microstructure Analysis of Oxide Ceramics Coating on Liquid Blanket Components

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An electrically insulating coating of an oxide ceramics is one of the attractive methods for reducing the magneto hydrodynamic (MHD) pressure drop which is a critical issue for liquid lithium fusion reactor blankets, and a ceramic coating for the inner wall would also be necessary to suppress the hydrogen permeation in a molten salt type blanket systems. Recently, we have succeeded techniques for large area coating fabrication of Er_2O_3 layers by using the Metal Organic Chemical Vapor Deposition (MOCVD) process in gas phase [1]. In this study, cross-sectioned TEM samples of Er_2O_3 coating layers on the SUS316 steel were fabricated by the focused ion beam (FIB) method, and its microstructure has been investigated by SEM and TEM to understand the growth mechanism fundamentally.

Fig. 1 (a) and (b) shows the outlook of coated Er_2O_3 thin film on SUS316 steel before and after hydrogen permeable test. There were no cracks and other defects on the surface. Fig. 1(c) and (d) shows SEM images marked by (3) in the Fig. 1 (a) and (b). There are small particles on the surface, these are 0.3 – 1.0 μm in diameter, and there is no difference about morphologies of their particle between samples before and after hydrogen permeable test.

Fig. 2 and 3 shows TEM images obtained for the Er_2O_3 thin film on SUS316 steel before and after hydrogen permeable test. In Fig. 2(a) and (b), thickness of coated Er_2O_3 thin film on SUS316 sheet was about 0.7 mm, and there is no adhesion and cracks between Er_2O_3 thin film on SUS316 sheet. Fig. 2(c) shows a selected area electron diffraction pattern obtained from the Er_2O_3 layer and it shows rings of crystallines, not diffuse pattern of amorphous structure. Er and O peaks were also detected from this layer by the energy dispersive X-ray spectroscopy. Also, columnar structure of Er_2O_3 crystalline perpendicular to the steel sheet has been confirmed in a dark field image of Fig. 2(b). This tendency has been confirmed in the sample after hydrogen permeable test as shown in Fig. 3. In the future work, we will investigate morphology and crystallography of Er_2O_3 layer deposited on the other materials.up largely as part of the restraining the warming of earth’s atmosphere.

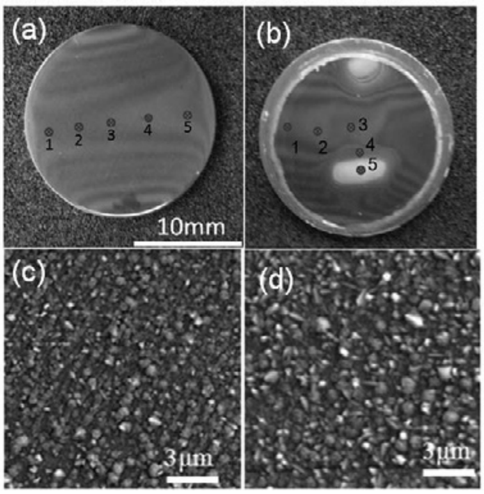

Fig. 1 Outlooks of coated Er_2O_3 thin film on SUS316 steel ((a), (b)) and its SEMimages((c), (d)).(a), (c):before and (b), (d):after hydrogen permeable test.

[1] Y. Hishinuma, T. Tanaka, T. Tanaka, T. Nagasaka, S. Yoshizawa, Y. Tasaki, T. Muroga, J. Nuclear Materials, 2011 (article in press).

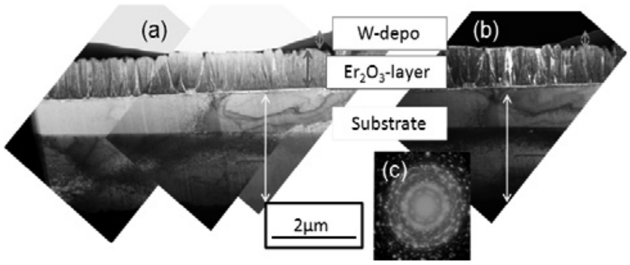

Fig. 2 TEM images obtained for the Er_2O_3 thin film on SUS316 steel before hydrogen permeable test. (a)a bright and (b)a dark field images.

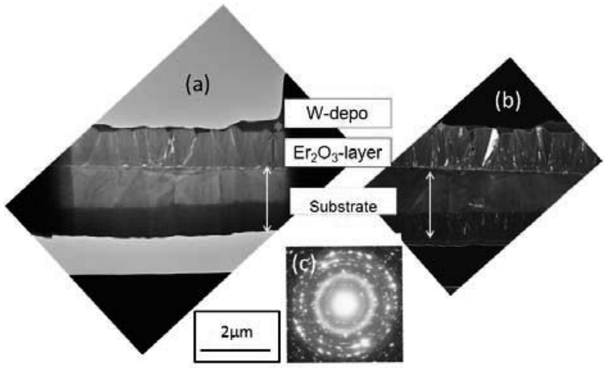

Fig. 3 TEM images obtained for the Er_2O_3 thin film on SUS316 steel after hydrogen permeable test. (a)a bright and (b)a dark field images.