§23. Microstructure Analysis of Oxide Ceramics Coating on Liquid Blanket Componens

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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, Hishinuma et al. 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 SUS substrate and substrates with some buffer layers were fabricated by the focused ion beam (FIB) method, and their microstructures have been investigated by XRD, SEM and TEM to understand their growth mechanism.

Fig. 1(a) shows XRD patterns by θ-2θ method obtained for Er_2O_3 layers on SUS substrate, and all peaks were in good agreement with the typical structure of Er_2O_3. Fig. 1(b) shows a SEM image obtained for its surface. White particles which have the average size of 1 μm in diameter were observed. The cross-sectioned TEM sample was fabricated from the central area of this sample for analysis of its microstructure. Fig. 1(c) shows that cross-sectioned TEM sample, and columnar structure was visible. The selected are diffraction pattern was obtained from the Er_2O_3 layer as ring patterns and it was indexed as the structure of Er_2O_3.

Fig. 2(a) shows XRD patterns by the thin film method obtained for Er_2O_3 layers with CeO_2 buffer layer on SUS substrate. All peaks were in good agreement with the typical structure of Er_2O_3 and CeO_2. Fig. 2(b) shows a SEM image obtained for its surface morphology. It shows smooth surface and it is quite different from Fig. 1(b). The cross-sectioned TEM sample was fabricated from the central area of this sample for analysis of its microstructure. Fig. 2(c) shows that cross-sectioned TEM sample, the CeO_2 buffer layer exists between Er_2O_3 and SUS substrate. The columnar structure of Er_2O_3 crystalline was also visible. There is also unknown dark contrast between the CeO_2 buffer layer and Er_2O_3 layer.

In the future work, we will clarify the relationship between these microstructures and properties as suitable materials for liquid lithium fusion reactor blankets.

[1] Y. Hishinuma, T. Tanaka, T. Tanaka, T. Nagasaka, S. Yoshizawa, Y. Tasaki, T. Muroga, J. Nuclear Materials, 2011.

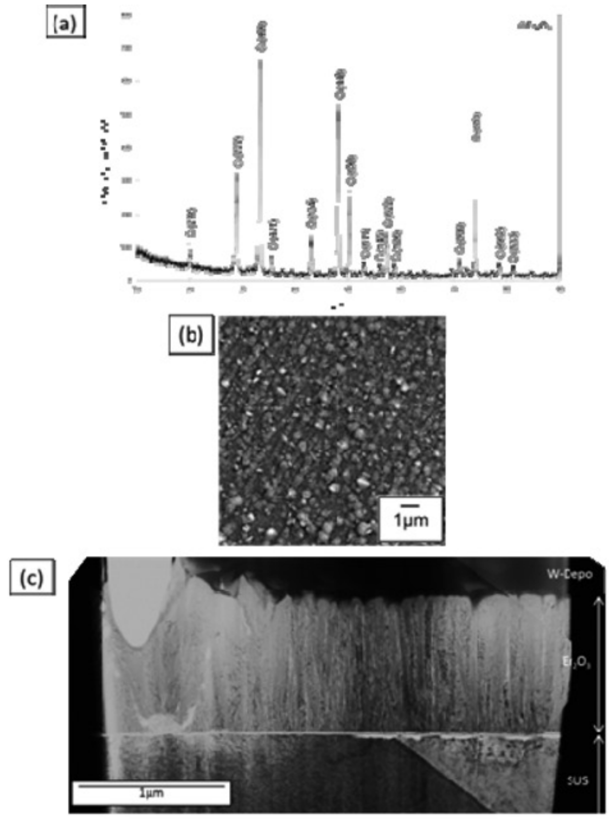

Fig.1 As-deposited Er_2O_3 sample on SUS substrate. (a)XRD pattern, (b)SEM and (c) cross-sectioned TEM images

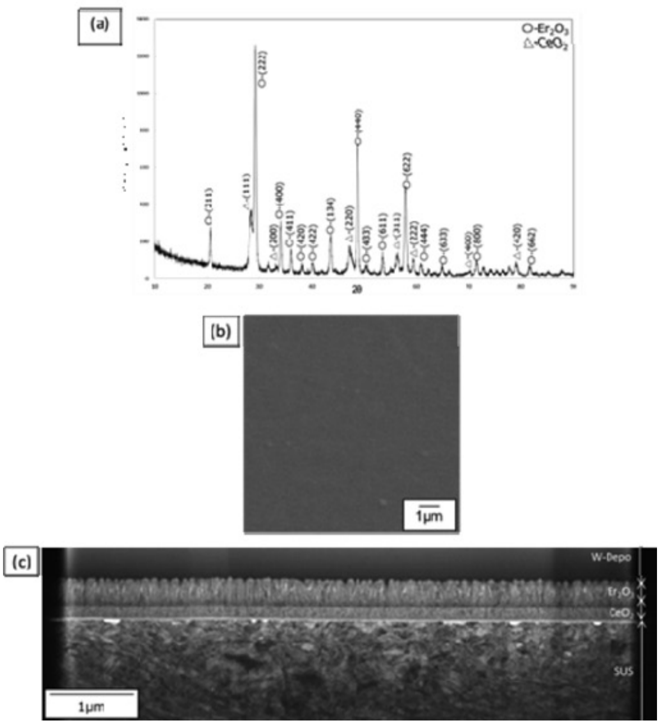

Fig.2 As-deposited Er_2O_3 sample with CeO_2 buffer layer on SUS substrate. (a)XRD pattern, (b) SEM and (c) cross-sectioned TEM images.