§5. Development of Oxide Insulator Coating Process in Advanced Liquid Breeder Blanket Systems

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The electrical insulating coating on the interior surface of the wall of duct tubing of liquid metal (Li) breeder blanket system is an attractive means for restraining Magneto-hydrodynamic (MHD) pressure drop. Vanadium alloy has been developed as a promising blanket material. [1] And Er_2O_3 was selected as one of the best candidate material for MHD insulating coating because of higher compatibility with Li.

In this report, Er_2O_3 thin film was fabricated on various kind of substrates by a metalorganic chemical vapor deposition (MOCVD) method which has advantages as films can be deposited in large area at high growth rates with high reproducibility.[2] The Er_2O_3 thin film was obtained on the inner surface of pipe-shaped substrate.

Two kinds of β-diketonates of Er were synthesized; tris[dipivaloylmethanato]erbium ($Er(DPM)_3$) and tris-[isobutyrylpivaloylmethanato]erbium ($Er(IBPM)_3$).

Preparation of Er_2O_3 thin films was carried out by means of the hot-wall typed quartz tube reactor. Deposition condition of Er_2O_3 films was shown in Table 1. Size of Si(100) and V alloy substrates was 5 x 20 mm.

Thickness and crystal structure of the thin films were estimated with a fluorescent X-Ray analyzer (XRF)and X-Ray diffractometer (XRD).

Table 1 . Deposition condition of Er_2O_3.

precursors	$Er(DPM)_3$, $Er(IBPM)_3$
substrate temperature	475°C
Ar carrier gas flow rate	200 sccm
O_2 gas flow rate	100 sccm
chamber pressure	10 torr
deeposition time	60 min
substrate	Si(100), Pt/Ti/SiO_2/Si V-4Cr-4Ti, quartz

Fig. 1 shows XRD patterns of Er_2O_3 thin films. Single phase Er_2O_3 was fabricated on the all substrates. The thickness of the film was 570 nm on the Si substrate.

Then, the Er_2O_3 films was deposited on the inner surface of pipe-shaped substrate with the mixed precursors

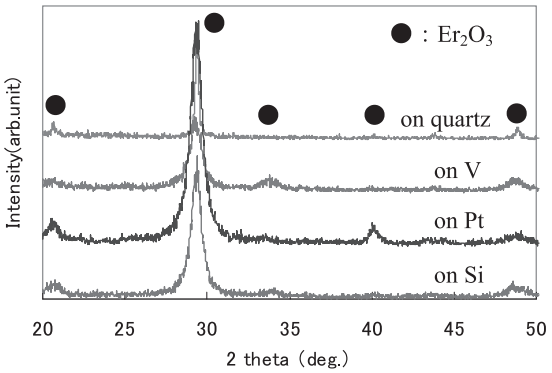

Fig. 1 XRD patterns of Er2O3 thin films.

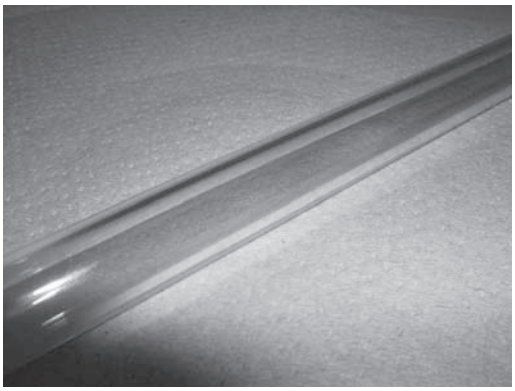

Fig. 2 Photograph of quartz pipe with Er_2O_3 thin film.

of Er(IBPM)3 and $Er(DPM)_3$. Photograph of the pipe-shaped quartz substrate after 3 hours deposition was shown in Fig. 2. The film with interference pattern was obtained in the area from 220 mm away the end of the pipe. The deposited amount of Er in the film around 50 mm area from the edge of the pipe was 3,242 μg. This Er amount indicated the film thickness of about 547nm. This is because it was possible to create the film over the wide-area into inner wall of the pipe with increase of the precursor pressure by using precursors with different oxidized decomposition temperature. However, as it was difficult to control the thickness of the film, the homogeneous film was not obtained.

1) Muroga, T. et al.: Review of advances in development of vanadium alloys and MHD insulator coating, J. Nuclear Mater., **367-370** (2007) 780-787.
2) Hishinuma, Y. Tanaka, T. Nagasaka, T. Muroga, T. Tasaki, Y. and Yoshizawa, S.: Er_2O_3 Coating on V and V-4Cr-4Ti Alloy through MOCVD Process for Advanced Liquid Breeder Blankets, 13th Inter. Conf. Fusion Reactor Mater., Nice, France, Dec, 2007.