Er$_2$O$_3$ coating on V and V-4Cr-4Ti alloy through MOCVD process for advanced liquid breeder blankets

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Magneto-hydrodynamic (MHD) pressure drop is one of the key issues for advanced liquid metal breeder blanket systems. The electrical insulating coating on the interior surface of the wall is an attractive concept for restraining of the MHD pressure drop. There have been a number of efforts to develop the MHD coating for liquid lithium (Li) -vanadium (V) alloy blanket system, and erbium oxide (Er$_2$O$_3$) was shown to be the promising candidate because of its high stability in liquid Li and high electrical resistivity. Er$_2$O$_3$ was also shown to be a potential candidate for tritium permeation barrier for Li-Pb or molten-salt blankets. However, most of the previous efforts utilized PVD coating technologies, which have limited capability in coating on complex surfaces expected in the blanket components. In the present study, we have applied Metal Organic Chemical Vapor Deposition (MOCVD) process for the coating. MOCVD is a vapor phase epitaxy growth which is synthesized via vapor phase from metal organic complex. Recently, MOCVD process is in practical use to product complicated shape semi-conductor and ferroelectric materials. In this study, Er$_2$O$_3$ coating layers were synthesized on metal V and V-4Cr-4Ti alloy using MOCVD process followed by various characterizations. By SEM observations, it was confirmed that thin coating layer formed within 10$\mu$m on V substrate. XRD analysis showed that Er$_2$O$_3$ single phase layer was formed on V substrate at 550$^\circ$C of substrate temperature. However, Er-V-O phase was also formed above 550$^\circ$C. In this paper, the effects of the synthesis conditions, such as temperature and environment, on microstructure and electrical property on Er$_2$O$_3$ coating layer through MOCVD process will be reported.

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