Seminar

Institute for Plasma Research

Title : Indigenous development and optimization of dip coating solutions for Er_2O_3 deposition

Speaker: Dr. Margi Jani
Institute for Plasma Research, Gandhinagar

Date : 28th November 2023 (Tuesday)

Time : 10.30 AM

Venue: Seminar Hall, IPR

Join the Talk: Online

https://meet.ipr.res.in/viewer/5418377697?be_auth=ODYzMTg0

(Conference ID: 5418377697; Password: 863184)

Abstract: Er_2O_3 is one of the potential candidates for hydrogen isotope permeation barrier application because of its favourable properties like very high Permeation Reduction Factor (PRF), chemical stability, high resistivity etc [1]. Er_2O_3 thin films prepared through Metal-organic decomposition by dip-coating technique using a commercially available dipping solution has been studied earlier [2]. However, a very high cost and import dependence of such solution is a big hindrance in up-scaling the deposition technique.

In this study, objective of the work is to develop indigenous solutions of Er_2O_3 for its coating through Metal-Organic Decomposition (MOD) by dip coating technique. $Er(NO_3)_3 \cdot 5H_2O$ is used as precursor and ethylene glycol methyl ether as alcohol based solvent [3]. Viscosity is an important property of dipping solution and is desired to be in specific range of value. Two different viscosity adjusters like Monoethanolamine (MEA) and Poly(ethylene glycol) bis(amine) are tried to add in the desired concentration in above solution. Such solutions with two alternative viscosity adjusters were characterized for their final viscosity and density values to ensure that they are within appropriate range. Subsequently, Er_2O_3 films were deposited on fused silica glass substrates using the developed solutions and characterized for crystal structure, microstructure and elemental composition of the film using X-ray diffraction (XRD), scanning electron microscopy (SEM) and Energy-dispersive X-ray spectroscopy (EDAX), respectively. XRD results show that Er_2O_3 forms in pure cubic crystal structure phase. EDAX clearly shows presence of erbium and oxygen on the coated surface seen under SEM. An estimation of wet thickness of the coating is calculated using the experimental parameters and tried to correlate it with the measured thickness of the coating under SEM.

Comparative study of Er_2O_3 thin films grown using the developed different dipping solutions and commercial solution is done and direction to further experiments for optimization of the concentration of the viscosity adjuster is determined. It is clearly observed through SEM that the solution with Poly(ethylene glycol) bis(amine) as a viscosity adjuster gives highly unstable coating with no complete coverage of the substrate surface. Whereas, the coating using alternate solution, with MEA as viscosity adjuster, shows complete substrate covering layer. Hence, systematic variation of MEA concentration in the solution and its effect on the resultant coating is planned for future experiments to improve and optimize the microstructure and uniformity of the coating.

References:

1. Compatibility of dip-coated Er_2O_3 coating by MOD method with liquid Li Fusion Engineering and Design 86 (2011) 2508–2511
2. P A Rayjada, "*Study of Er_2O_3 Film Deposition by Different Techniques for the Fusion Reactor Applications*" Ph. D. thesis, Sardar Patel University, Vallabh Vidyanagar, Jan, 2017 (http://hdl.handle.net/10603/146486)
3. CF-LIBS analysis in depth profile of lithium corrosion resistance of Er_2O_3 coatings prepared by sol-gel method Fusion Engineering and Design 170 (2021) 112506