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Er2O3 Coating by Multilayer Metallic Sputtering and Intermediate Oxidation Approach

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Er2O3 (erbia) is a leading candidate for hydrogen isotope barrier and electrical insulation coating application in some sub-systems of advanced nuclear fusion research reactor designs. Due to harsh environment of the reactor, structural and microstructural stability of the coatings at elevated temperature is critical. The polymorphs of erbia are reported in cubic, monoclinic and hexagonal phases depending on the ambience of the formation. Cubic is the most stable phase among these as it does not transform up to 2327 C. Hence, it is important to choose and tune the deposition process so as to obtain cubic phase Er2O3 coatings with dense packed and compact microstructure.

Our previous study conclusively showed that reactive sputter deposition leads either to a coating with monoclinic phase and compact microstructure or to cubic phase and cracked/bulged microstructure, depending on the process temperature. Also inferred from the study was that metallic Erbium deposition converts into cubic phase upon post oxidation. Hence, a novel approach of depositing thin multilayers (~40 nm) of Erbium with intermediate in-situ oxidation has been adopted in this work. The structural phases and microstructure of the deposited films are studied using X-Ray Diffraction (XRD), Grazing Incidence Diffraction (GID) and Scanning Electron Microscope (SEM). The variation in these properties is correlated with the variation in process parameters such as layer thickness, oxidation duration, temperature, post annealing, etc. The detailed results of this study in comparison to those of reactive sputter deposition will be presented in this paper.

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