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High performance alumina based gas diffusion barrier

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Nowadays,more and more technologies,ranging from promising organic-based devices (OBDs) to nuclear fusion reactors,pose hard materials challenging.Unfortunately,OBDs are affected to the degradation of their organic-based material in contact with moisture and oxygen that cause its limited lifetime.Currently,the only commercial and useful technique in order to protect OBDs is glass encapsulation.Glass encapslutation is affected to high cost and fragility.In order to tackle fragility keeping the barrier behaviour of the glass,metal oxides coatings by means deposition techniques,including ALD,CVD,Sputtering process and Sol-gel are the major candidates.Metal oxides are promising materials in the developing of future fusion reactors,too.These machines will use eutectic lead-lithium in order to perform tritium breeding.Thus,tritium permeation into cooling system represent an important technological issue.Metal oxide coatings reveal a powerful capacity to tackle tritium permeation.Unfortunately,deposition techniques cited before,are not able to produce fully protecting coatings.Coating defects lead to produce complex multi-layered films to protect OBDs against moisture.Mechanical mismatching,porosity and non-uniformity are the bottle neck in coating development for future fusion reactors.Here,we report on a very performance monolayered coating, Al_2O_3,deposited by PLD technique,suitable towards these tasks thanks to its chemical inertia,high density and amorphous character.Permeation tests are carried out by means the calcium test for OBDs exposed to moisture and measuring by a quadrupole mass spectrometer the increasing of hydrogen concentration due to the permeation phenomenon.Calcium test measures were carried out into a climatic chamber up to 85°C and 85% of RH obtaining an unprecedentedly WVTR of monolayer Al_2O_3,namely values of 10^{-8} $g.m^{-2}.day^{-1}$ at room temperature.Instead,Eurofer97 steel disks are covered with different Al_2O_3 thicknesses and exposed to 100mBar hydrogen partial pressureu p to 650°C.Results show a promising value of permeation reduction factor up to 6000.

Keywords
PLD-Alumina
Ultra-low permeation barrier