ADVANCES IN THE ELECTROPHORETIC PROCESS (EPD) TO CONTROL THE OXIDE COATINGS MICROSTRUCTURE: APPLICATION TO ENVIRONMENTAL BARRIER COATING

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Environmental barrier coatings (EBCs) are needed to protect SiC-based ceramic materials against water vapour corrosion at high temperature. The development of such coating systems is necessary to implement SiC/SiC ceramic matrix composites (CMCs) in hot section components of advanced gas turbine machine. The properties of EBCs vary with the different preparation processes. There are varieties of methods to produce ceramic coatings, such as chemical vapour deposition (CVD), physical vapour deposition (PVD), ion implantation, thermal-spray, sol-gel and newly developed electrophoretic deposition (EPD). In this work, ytterbium disilicate $Yb_2Si_2O_7$ is used as material for EBCs, because it has an excellent resistance to volatilization and a thermal expansion coefficient close to the SiC/SiC substrate one. The aim of this work is to investigate the electrophoretic deposition of ytterbium disilicate ($Yb_2Si_2O_7$) coatings from suspension prepared with isopropanol and iodine (I_2) as dispersant, and to study the effect of different parameters such as the iodine concentration, applied voltage and deposition time on the EPD kinetics and on the $Yb_2Si_2O_7$ coatings properties. It was observed that the mass of the deposited coating reaches a maximum value for $[I_2]$=0.2g/L, and the coating microstructure becomes porous at high iodine concentration, because of the increase of free protons into the suspension. It was proved that porosity increases with the increase of applied voltage, and a compaction occurs when the deposition time increases. Figure 1 exhibits the different microstructures as a function of the iodine concentration at short and long times. It can be seen the formation of a porous zone in the vicinity of the substrate for the deposited coatings with iodine, and an uniform coating without iodine. As the iodine concentration increases, so does the free protons concentration, as well as the porous zone near the substrate. After 600s of deposition duration, deposits are denser. This is related to the decrease of the deposition rate, both due to the increase of the electrical resistance of the deposit R_d and the decrease of the electric field E_{eff}. The coating forms without iodine is 20% denser at t_d=600s than at t_d=180s. Coatings form with iodine are about 10% denser at t_d=600s.

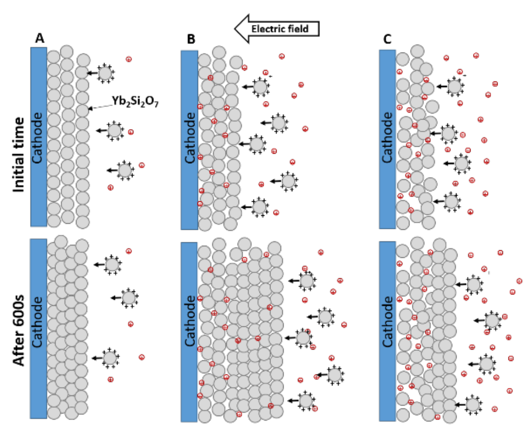

Figure 1 Schematic illustration of the coatings deposited at 100V, from the suspension with (A) $[I_2]$=0 g/L, (B) $[I_2]$=0.1-0.3g/L and (C) $[I_2]$=0.8g/L, at short time and after 600s