Studies on corrosion behavior of Ni-based alumina and chromia forming nanocrystailline coatings in simulate marine environment

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Abstract Nanocrystalline coating with the same chemical composition as the alloy substrate was proved to possess high resistance to oxidation and scale spallation, meanwhile avoid notable elements interdiffusion. It opens up a new direction for the development of protective coatings. However, in a worse environment containing chlorine and water vapor, the ultrafine grains act like a double-edged sword, which can promote the formation of a protective scale of Al_2O_3 or Cr_2O_3, but also favor the inward diffusion of Cl and H_2O to accelerate corrosion. In order to solve this problem, for Al_2O_3-forming coatings, chlorination and/or oxidation of Ta ruined compactness of the oxide scale. The yttrium modified nanocrystalline coating by inhibiting the outward diffusion of Ta provides the highest corrosion resistance. For Cr_2O_3-forming coatings, moderate amount of oxygen was doped into nanocrystalline coating during magnetron sputtering. the doped oxygen can attract active elements of Ti and Al to form TiO_2 and θ-Al_2O_3, which pinned at grain boundaries to keep the ultrafine grains stable at high temperature while prevent inward diffusion of the corrosive media. Accordingly, a dense and pure chromia scale was formed quickly at surface, ensuring that the oxygen-doped nanocrystalline coating provided the highest corrosion resistance under the synergy of solid NaCl deposit and water vapor.

Keywords Nanocrystalline coatings; High-temperature corrosion; Chlorination; Water vapor