PO3048

Corrosion protection of zirconium surface based on Zr-Fe-Si Heusler alloy fabricated by magnetron sputtering

Jan Lancok[1], Katerina Horáková[1], Stanislav Cichon[1], Vladimir Chab[1], Aneta Krausova[2], Jan Macak[2]

[1]Institute of Physics CAS, Prague, Czech Republic [2]University of Chemistry and Technology, Prague, Czech Republic

lancok@fzu.cz

Zirconium is a very useful material for various technical applications especially in nuclear industry due to low neutron capture cross-section or as a getter for storage of hydrogen. Unfortunatelly the Zr alloys changed by oxygen/hydrogen diffusion are less dense and are mechanically weaker than the original material. The processes of Zr alloys oxidation and hydrogenation lead to limitation criteria in justifying fuel rod life time. To develop new protective coatings of claddings we performed three different studies: Firstly we systematically studied the Zr H interaction which is the crucial step for theory, data interpretation and technology on the surface sensitive techniques on the Zr(0001) single crystal. Secondly we studied initial stages of Fe and Si atoms interactions with Zr (0001) surface. Ultrathin Fe-Si films were evaporated on the Zr(0001) surface. The formation of the stable corrosion resistance. Fe2ZrSi or FeZrSi Heusler alloys was formed, which addresses the problem with hydrogen. Finally by means of DC magnetron sputtering the multicomponenct gradient films Fe-Si-Zr from Zr, Fe and Si targets were fabricated on polycrystalline disc Zr (99%) with diameter 12 mm. The depositions were carried out in UHV conditions in pure argon atmosphere at substrate temperature varied from 20-700 °C. The properties of all films were studied by surface techniques such as STM, AFM and by NanoESCA instrument, which is a based on a PEEM (Photoelectron Emission Microscope) and PES (Photoelecton Spectroscopy). The structural properties were characterized by XRD and SEM equipped by EDX and EDSB techniques. Electrochemical Impedance Spectroscopy was employed to analyse the corrosion characterization of Zr with protective Heusler-like films. The effect of Fe-Si-Zr films composition and structure on surface chemistry, morphology and corrosion behaviour of Zr was examined and evaluated.

Keywords
magnetron sputtering
corrosion protection
zirconium
Heusler alloys
thin film