Seminar

Institute for Plasma Research

Title : Development of Aluminide coating on Ni based super-alloys

Speaker: Dr. Arunsinh B. Zala
Institute for Plasma Research, Gandhinagar

Date : 02nd June, 2022 (Thursday)

Time : 03.00 PM

Venue : Online - Join the talk:
https://lobby.ipr.res.in/PDFExtensionTalk_ArunsinhZala

Abstract :

Ni-based super alloys are widely utilized in various sectors such as aircraft, marine, chemical industries, thermal and nuclear power plants. However, use of such superalloys are in certain cases limited by issues such as corrosion and high temperature oxidation, which eventually deteriorates the performance and life span of component. One such application is the Joule Heated Ceramic Melter (JCHM) for the vitrification & immobilization of high-level radioactive waste of nuclear fission power plants. Major problems associated with this type of vitrification technique includes, but not restricted to, pre-mature degradation of melter pot and electrode material, clogging of pour spouts due to corrosion. Plasma assisted diffusion treatments which produce 50-100 µm thick diffused nickel aluminide along with stable alumina coatings have very good oxidation resistance and can prove beneficial against these issues. Such plasma assisted aluminide coatings have not been reported so far for such application. It is thus important to study the effect of such plasma-based diffusion heat treatment on the microstructure of the alloy, its bulk properties and the impact on the resistance to corrosion against borosilicate glass.

The work done in first year includes the identification of lacunae, generating an Ni-Al diffusion aluminide coating by hot-dip aluminizing (HDA) followed by oxygen plasma assisted diffusion heat treatment. The plasma assisted heat treatment involved thermal exposure at 900°C/5 h for generating stable intermetallic compounds. The processed samples were characterized to investigate the effect of heat-treatment on bulk material. X-ray diffraction studies revealed the presence of Al_2O_3 layer followed by NiAl, Cr_5Al_8 and FeAl phases in the interdiffusion region. These phases and their microstructures have been investigated with both, optical and scanning electron microscopy. Back scattered images through SEM indicates distinguished intermetallic precipitates and supports the XRD data. In addition, elemental depth analysis via EDS further confirmed the elemental distribution of phases. The Vickers micro-hardness results were ranging from 724 $HV_{0.1}$ to 945 $HV_{0.1}$ which are in agreement with the phases reported and discussed in this study. To put in nutshell, the work comprises of importance of aluminizing, experimental details and characterization along with the comparison and interpretations of results on the basis of various microstructural aspects. Future work involves mechanical property evaluation and corrosion tests against molten borosilicate glass.