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P4.163 Investigation of Alumina Films Formed over Aluminized RAFM steels by Plasma Assisted Heat Treatments

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Reduced Activation Ferritic Martensitic (RAFM) steel is currently under intense consideration as a structural material for the blanket applications in fusion reactor. The concept of blanket module utilizes both solid i.e. Li2TiO3 and liquid breeder material, i.e. Eutectic Pb-17Li operating at 320-480C. The critical issues like liquid metal corrosion of RAFM steel, tritium permeation into RAFM steel and magneto hydrodynamic drag generation due to flowing Pb–17Li is already reported. αAl2O3 + FeAl coatings have been found promising to mitigate these challenges & reported with a substrate of P91 steels. However, coatings with hot dipping process on RAFM is scarcely reported as RAFM steel is in under development. Hence, an experimental investigation is done to examine the effects of heat treatments to form FeAl with a top layer of Al2O3.
In-RAFM steel (9Cr-1.4W-0.06Ta) samples are hot dipped in a molten bath of 93%Al & 7%Si at 730C. These hot dipped samples are subjected to various heat treatments in 3 different routes. In the 1st route, normalizing heat treatment will carried out at 980C for 30minutes followed by thermal tempering in a muffle furnace at 760C for 90minutes. 2nd route consists of plasma tempering along with normalizing in which O2 will use at low pressure (5mbar) at 760C/90minutes with pulsed DC at -520V. Whereas in third route, to form α-Al2O3, plasma assisted heat treatments will get conducted directly without normalizing up to 24hrs. The transformations of these phases have been analyzed through X-ray diffraction. Moreover, to confirm Al2O3 coatings, its thickness as well as the case depth of diffused FeAl, cross section of coated samples were investigated by mapping and elemental depth profiling through SEM equipped with energy dispersive x-rays. Hence, this experimental study will address the phase transformations occurred during various heat treatments and its effect on formation of alumina films.

Presenter: ZALA, Arunsinh (FCIPT IPR Instittue for Plasma Research ” Homi Bhabha National Institute Gandhinagar)

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