**RADIATION DAMAGE EFFECT ON STRUCTURAL AND MECHANICAL PROPERTIES OF INERT ZrN LAYER: CORROSION MITIGATION IN LBE COOLING ENVIRONMENT**

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Due to its multiple advantage, low thermal neutron absorption cross section, radiation damage tolerance, low melting temperature, high boiling temperature and non-reactive with air and water, Lead-Bismuth Eutectic (LBE) is a primary candidate for use as a target for the production of a spallation neutron source [1] and as the coolant for advanced nuclear reactors systems (Gen. IV) [2, 3]. Detailed data regarding liquid metal coolant and in particular LBE have been reported in reference [4] and references therein. However, the main disadvantage of LBE is that it is corrosive. In order to remedy this, several inhibitors have been proposed, in particular Zirconium (Zr). The reaction of Zr with the nitrogen of the steel container leads to the formation of a protective layer of ZrN. It is likely that fast neutrons from fission or fusion reactions affect the properties of the ZrN layer and therefore enhance the corrosion process. Hence the importance of knowing precisely the evolution of the properties of ZrN under irradiation.

In this communication, ZrN coatings were deposited on zircaloy-4 substrate using high power impulse magnetron sputteringtechnique and irradiated by 2 MeV Proton in the fluence range of 1×1013 p.cm-2 - 1×1015 p.cm-2. Our aim is to emulate fast neutrons radiation damage in ZrN coatings. Several tools were used for damage characterization, namely: grazing X-ray diffraction, atomic force microscopy (AFM) and nanoindentation.

According to our experimental data, it was found: (i) successful elaboration of ZrN coatings with cubic structure with a preferred orientation (111); (ii) irradiation induces an improvement of crystallinity without swelling and contraction; (iii) nanoindentation measurements reveal no significant change in nanohardness and Young's modulus. These results confirm the high radiation tolerance of the ZrN coating against 2 MeV proton in the studied fluence range. Therefore, the ZrN protective layer formed will not be affected by irradiation, which will mitigate LBE corrosion.

References

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