SYNTHESIS AND IRRADIATION EFFECTS ON CRNBTAVW$_X$ HIGH ENTROPY ALLOYS

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During operation of a nuclear fusion reactor the divertor region stands high heat fluxes making the thermal compatibility between the low-working temperature heat sink material (CuCrZr) - which embrittles under irradiation - and the plasma-facing W tiles a major problem. An appropriate solution to address this discrepancy and to sustain irradiation damage is the introduction of a thermal barrier interlayer.

In this work CrNbTaVW$_x$ high entropy alloys have been devised for thermal barriers. Alloys with 20 at.% and 30 at.% of W have been prepared by ball milling and consolidation by Upgrade Field Assisted Sintering Technology (U-FAST) at temperature of 1600 ºC under a pressure of 90 MPa. Irradiation of the equiatomic CrNbTaVW sample was carried out at room temperature with Ar^+ (300 keV) beams with a fluence of 3 x 10^{20} at/m^2 at 25ºC, 200ºC and 400ºC. Structural changes prior and after irradiation were investigated by scanning electron microscopy, coupled with energy dispersive X-ray spectroscopy and X-ray diffraction and thermal stability was evaluated. The diffractogram of the raw powder mixture shows peaks of the individual elements in the alloy. After 2 hours of milling the X-ray pattern changed drastically, indicating the formation of a BCC structure with a minor fraction of WC. Moreover, after consolidation the diffractograms for both compositions evidence two BCC structures together with minor phases identified as Ta-Cr and Ta-V rich. In addition, no significant phase transformation was observed in these samples in the range from 25 ºC to 1500 ºC range which is a good indication of thermal stability of the materials in this temperature range. No severe superficial modifications were observed, after irradiation.