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P2.200 Irradiation of the copper-based high entropy alloys for nuclear fusion

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Nuclear fusion is a promising way to fulfill the current and future energy needs in a cleaner way and many challenges must be overcome to be able to achieve a sustained nuclear fusion reaction. Tungsten with a high melting point, high sputtering threshold and low tritium inventory is the choice for the plasma facing material and CuCrZr alloy, with high conductivity and strength, for the heat sink material. The problem arises in the mismatch on the properties of both materials: the high ductile-brittle transition (DBTT) temperature for tungsten, while CuCrZr possesses a low service temperature. The thermal properties mismatch might lead to W-CuCrZr interface damages and lower time-life service for the materials used, and therefore, a thermal barrier layer is necessary. High entropy alloys have interesting properties such as low thermal diffusivity and form homogenous materials with simple structures, which put them as candidates for thermal barrier layers. In this work, high entropy alloys were prepared with the composition CuxCrFeTiV (x = 5, 10, 20, 30 at.%) using mechanical alloying of mixes of elemental powders followed by spark plasma sintering at 1178 K and 65 MPa. One sintered CuCrFeTiV sample was irradiated at room temperature with 300 keV Ar+ ions to a fluence of 3×1020 at/m2. The samples were characterized by scanning electron microscopy coupled with energy dispersive X-ray spectroscopy and X-ray diffraction. Preliminary results showed the presence of heterogenous and multiphasic microstructures. The diffractograms of the as-sintered samples revealed two FCC structures the minor fraction with lattice parameter similar to Cu. After irradiation the CrCuFeTiV diffractogram revealed the coexistence the Cu-like FCC structure with a dominating BCC structure, implying/suggesting that the minor Cu-like FCC structure remained unchanged, while the original dominant FCC structure dissapeared, giving rise to a BCC structure.

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