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Swift heavy ion irradiation damage in Ti-6Al-4V and Ti-6Al-4V-1B: Study of the microstructure and mechanical properties

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Due to their excellent mechanical properties, corrosion resistance, fatigue strength, low density and low activation under irradiation, titanium (Ti) alloys are currently being considered for use as a structural material for the beam dump shell for the Facility for Rare Isotope Beams (FRIB): A new generation accelerator with high power heavy ion beams. The capability of the FRIB to operate at full beam power depends on the beam dump being able to absorb up to a 325 kW beam power (with primary Beam from O to U). Ti-6Al-4V (grade 5) is the preferred candidate for this beam dump shell material. A significant increase of beam dump lifetime with respect to fatigue due to thermal cycling can be expected for the rotating beam dump if Ti-6Al-4V with an addition of 1% boron (Ti-6Al-4V-1B) is used [1].

Two sets of samples of both Ti-6Al-4V and Ti-6Al-4V-1B were irradiated at the IRRSUD beam line at the GANIL CIMAP, Caen France with swift heavy ion beams respectively 36Ar (36MeV, Se =7.5keV/nm) and 131Xe (92MeV, Se =19.7 keV/nm).
The samples were polished and etched before irradiation and selected areas on the surfaces of the samples were characterized before and after irradiation using Scanning Electron Microscopy and Electron Backscatter Diffraction. In addition, Vickers hardness and nano-indentation measurements were also used to probe the change in hardness and elastic modulus as a function of the depth.

This talk will describe irradiation setups and the post irradiation techniques used to characterize the material. The results indicate a low-radiation damage sensitivity in both materials.

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[1] W. Chen, C. J. Boehlert (2009). Materials Transactions„ Vol. 50, No. 7 pp. 1690 to 1703.

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