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Material Irradiation Studies at ISAC-TRIUMF: Progress, Highlights, and Prospects

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Following the successful implementation of the ISAC parasitic irradiation pilot program in 2021, material irradiation targets have become a routine part of the ISAC target operational schedule. To date, a total of 12 in-beam parasitic targets have been irradiated, resulting in the examination of approximately 300 samples irradiated up to 3.5 DPA-NRT and 100 appm He/DPA. The materials studied comprise five different metallic material candidates for beam intercepting components including additive manufacturing aluminum alloy and high entropy alloys. Furthermore, off-beam irradiation of polymeric materials has been conducted to evaluate the use of PEEK (Polyether Ether Ketone) in future ARIEL target vessels to doses up to 100MGy. Mechanical and microstructural characterization of the irradiated metallic samples has been performed using small punch testing (SPT) at TRIUMF and transmission electron microscope (TEM) in collaboration with Canadian Nuclear Laboratories (CNL). Analysis of PEEK degradation has been performed by He-leak testing of spring energized PEEK seals, SPT and size exclusion chromatography (SEC). Moving forward, collaboration with CNL and other external institutions in the field of small modular reactors (SMRs) have the prospects of irradiating materials at high temperatures for which upgraded capabilities will be required. This overview will highlight findings from previous studies and discuss the plans for future irradiation campaigns and system upgrades for material irradiation studies at TRIUMF.

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