



Radiation responses of additive manufactured stainless steel

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Abstract:

Additive-manufactured (AM) alloys have been proposed for nuclear reactor applications, for the advantages in reducing materials manufacturing costs and facilitating urgent on-site replacement. The method is particularly attractive for the flexibility to produce complicated geometry. Additive manufacturing, however, creates various unique micro-structures, which can lead to unique behaviors under neutron and ion irradiation. The impact of these structures on overall performance needs to be systematically evaluated. The project aims to identify the correlations between irradiation responses and characteristic features of AM alloys. Hence we can establish the relationship between irradiation tolerance and processing parameters. Neutron irradiations can take a significantly long time to complete, therefore to get meaningful data in a timely manner, irradiations have been performed with both light and heavy ions. The irradiation responses that are being investigated include void swelling, precipitation, and boundary segregation. Heavy ion irradiations were performed in order to investigate void swelling at high damage levels. Light ion irradiations were used for the investigation of both precipitation and boundary segregation. Knowledge on the aforementioned responses is necessary for the application of additive manufactured alloys in reactor environments and to further optimization of the AM process. Here, we will report our recent research findings on effect of processing introduced-cavities on elemental segregation, local phase change, local strain, and subsequent severe deformation and irradiation. The plan for the FY2022 will also be discussed.