Effect of Temperature and Friction Stir Welding on Microstructure Evolution on Self-Ion Irradiated MA956 up to 25 dpa

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Fabrication of reactor cladding of advanced materials remains a challenge to the nuclear materials community. In particular, maintaining the small grains (<1 μm) and dispersoids in oxide dispersion strengthened steels is a challenge during the weld process. Friction stir welding is a promising technique for minimizing the detrimental effects of joining. The microstructure of welded and irradiated MA956 was examined at temperatures from 400 to 500ºC up to 25 dpa. Irradiations were performed with 5 MeV Fe^{++} ions on samples irradiated with a rastered beam on a 6 MV Tandem accelerator at Sandia National Laboratory. The precipitate and void behavior was analyzed using scanning transmission electron microscopy (STEM) in bright field (BF) and high angle annular dark field (HAADF), respectively, while dislocation loops and network were analyzed with BF imaging in the weak two beam condition. The dispersoids re-solutioned during the welding process re-precipitated in the welded material after irradiation regardless of temperature; however, the evolution of the dispersoid microstructure with respect to diameter, number density and volume fraction varied with both welding and temperature.