

Capacitive Discharge Resistance Welding for ODS Steel Cladding: Weld Properties and Radiation Resistance

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Abstract:

Ferritic oxide dispersion strengthened (ODS) steels possess considerable advantages over conventional structural materials in strength, creep resistance, and radiation tolerance at high temperature, but the tendency of nanoscale oxide particles to agglomerate in a melt or redistribute toward the surface (e.g., during fusion welding) poses a significant challenge to joining ODS alloy components. While friction stir welding has shown some promise for the solid-state welding of ODS materials, the process does not lend itself to the small diameter, thin walled tubes used for cladding. A capacitive discharge resistance welding (CDRW) technique was thus adapted for the task and used to join like segments of the ODS alloys 14YWT and MA956. Comprehensive characterization of the base and welded material was carried out using optical microscopy, diffraction orientation mapping (EBSD), and electron microscopy (S/TEM), with microstructural evolution under various welding and irradiation (1 MeV H⁺, 4 MeV Fe²⁺) conditions compared in detail for the alloys.