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Characterization of dissimilar 9 Cr-1Mo ferritic steel - 316LN austenitic stainless steel weldments during tensile deformation using IR thermography

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Abstract

Dissimilar metal welds between austenitic stainless steels and chromium molybdenum ferritic steels are being widely used in many elevated temperature applications. The austenitic stainless steel (316LN) with superior creep strength and oxidation resistance are required in the higher temperature regions while creep resistant ferritic steels like 9Cr-1Mo steels (P91) are commercially more attractive for the lower temperature sections in liquid metal reactors. This work employs thermal imaging during tensile deformation of laser welded P91 – 316LN dissimilar weldments for early detection of necking and failure zones. Infrared thermography in combination with uniaxial tensile testing has been widely used for characterization of weldments. This technique can be used in characterizing dissimilar welds which exhibits peculiar behavior during tensile deformation. A fast array based thermal detector was used to map the temperature distributions which reveals the stress concentration was primarily along 316LN base material, but later moved towards P91 side. This clearly portrayed that the tensile elongation of P91 steel was inferior to 316LN stainless steel and the primary fracture location was observed at P91 base material. It also confirmed that the weld zone was comparably stronger than the parent materials.

Keywords: austenitic stainless steel, ferritic steel, laser welding, tensile testing, IR Thermography