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Effect of Cladding Direction on Residual Stress Distribution in Laser Cladded Rails

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Abstract : In this investigation, a laser cladding process with a powder feeding was used to deposit stainless steel 410L (high strength, excellent resistance to abrasion and corrosion, and great laser compatibility) onto railhead (higher strength, heat treated hypereutectoid rail grade manufactured in accordance with the requirements of European standard EN 13674 Part 1 for R400HT grade), to investigate the development and controllability of process-induced residual stress in the cladding, heat-affected zone (HAZ) and substrate and to analyse their correlation with hardness profile during two different laser cladding directions (across and along the track). Residual stresses were analysed by neutron diffraction at OPAL reactor, ANSTO. Neutron diffraction was carried out on the samples in longitudinal (parallel to the rail), transverse (perpendicular to the rail) and normal (through thickness) directions with high spatial resolution through the thickness. Due to the thick rail and thin cladding, 4 mm thick reference samples were prepared from every specimen by Electric Discharge Machining (EDM). Metallography across the laser claded sample revealed four distinct zones: The clad zone, the dilution zone, HAZ and the substrate. Compressive residual stresses were found in the clad zone and tensile residual stress in the dilution zone and HAZ. Laser cladding in longitudinally cladding induced higher tensile stress in the HAZ, whereas transversely cladding rail showed lower tensile behavior.
Keywords : laser cladding, residual stress, neutron diffraction, HAZ
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