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Investigation of a novel functionally graded material for the repair of premium hypereutectoid rails using laser cladding technology

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Abstract

In this study, the effects of cladding direction, preheating and post heat treatment on microstructural and mechanical properties of laser cladded rail repairs are presented. Laser cladding of a premium hypereutectoid rails grade with 410L stainless steel powder were conducted using a fibre laser gun with a powder feeder. Two different cladding directions and different heat treatment regimes were investigated. An excellent microstructural consistency was established across the railhead and its heat affected zone (HAZ) by changing cladding direction and using a heat treatment consisting of pre-heating and post-heating. The microstructure of the cladding layer and HAZ were characterised by optical microscopy and SEM. Phase identification and distribution were investigated by using XRD, EDS, and EBSD. Indications of the mechanical and tribological performance of the cladding layer in wheel-rail contact were obtained via shear punch tests and Vickers indentation, which demonstrated great correlation with the obtained microstructure.

Keywords:

Laser cladding; 410L stainless steel; Hypereutectoid rail steels; Microstructure; Cladding direction; Heat treatment.