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Effect of different cladding alloys and grinding on residual stress in laser clad light rail components using neutron diffraction

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One of the greatest challenges threatening Australia's railway infrastructure is the rapid rate of rail degradation. Wear and rolling contact fatigue occur due to increasing speeds and tonnages of rollingstock, requiring significant funding by the Australian government to maintain. Light rail is particularly susceptible to degradation due to low carbon steel used in tram switch blades.

Laser cladding is a repair strategy which applies a metallic deposition by melting a cladding powder with the substrate using a high energy laser. This process forms a metallurgical bonded layer whilst generating a heat affected zone (HAZ) containing a redistribution of residual stress due to phase changes and solidification shrinkage from the thermal inputs.

During operation, cyclic wheel-rail contact stress is superimposed on the residual stress leading to fatigue. The ability to accurately measure residual stresses non-destructively, made possible using neutron diffraction, is critical in experimentally obtaining stress data for fatigue assessment. Laser cladding has been carried out on ex-service switch blades using a martensitic stainless steel and two Stellite alloys. A standard grinding procedure has been performed to replicate the stress conditions experienced in-field after cladding repairs.

Strain measurements were undertaken on the Kowari strain scanner at ANSTO to determine the tri-axial stress across the cladding, HAZ and substrate. The locations of the fusion boundary and HAZ have been identified through correlation of the stress, microstrain and full width at half maximum profiles. These findings accompany extensive evaluation of microstructure and mechanical properties to optimise laser cladding repairs in light rail components.

Level of Expertise

Student

Presenter Gender

Woman

Pronouns

She/Her

Which facility did you use for your research

Australian Centre for Neutron Scattering

Students Only - Are you interested in AINSE student funding

Yes

Do you wish to take part in the Student Poster Slam

No

Condition of submission

Yes

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