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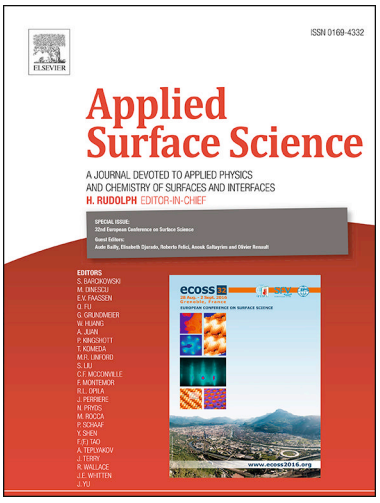

Full Length Article

Investigation on the microstructure and damage characteristics of wheel and rail materials subject to laser dispersed quenching

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Investigation on the microstructure and damage characteristics of wheel and rail materials subject to laser dispersed quenching

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Abstract: Laser dispersed quenching (LDQ) forms isolated hardening zones distributed in a certain arrangement on the material surface. This study explores the microstructure, wear and rolling contact fatigue (RCF) of wheel and rail materials that have been treated by laser dispersed quenching. Through microstructure and surface hardness analysis, the optimum laser processing parameters of the wheel/rail materials are determined to be a laser power of 900 W and a laser quenching time of 0.6 s. Homogeneous martensite is obtained in the LDQ region of the wheel/rail rollers, and the surface hardness of the LDQ region significantly increases, which improves the wear resistance of wheel and rail materials. With an increase in LDQ spacing, the wear resistance and surface damage of the wheel/rail rollers deteriorate, and the optimum LDQ spacing is 0.3 mm. Severe spalling occurs on the surface of untreated wheel and rail rollers, while fatigue wear dominates in the LDQ region of the wheel and rail rollers. Meanwhile, small spalling is dominant in the substrate region between adjacent LDQ regions. Furthermore, the RCF life of wheel/rail rollers subject to LDQ is approximately 2 times that of untreated wheel/rail rollers under water condition.

Keywords: Wheel/rail materials; Laser dispersed quenching; Microstructure; Wear; Rolling contact fatigue

1. Introduction

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