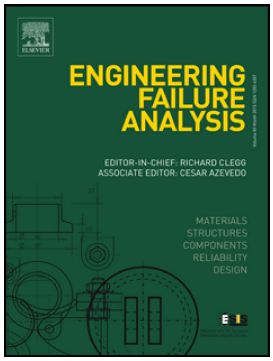

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PII: S1350-6307(16)30966-9
DOI: doi: 10.1016/j.engfailanal.2017.03.005
Reference: EFA 3061

To appear in: *Engineering Failure Analysis*

Received date: 18 October 2016
Revised date: 15 February 2017
Accepted date: 7 March 2017

Please cite this article as: WenJing Chen, Hui Chen, CongChen Li, Xiaoli Wang, Qing Cai , Microstructure and fatigue crack growth of EA4T steel in laser cladding remanufacturing. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Efa(2017), doi: 10.1016/j.engfailanal.2017.03.005

Microstructure and Fatigue Crack Growth of EA4T Steel in Laser Cladding Remanufacturing

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Abstract

EA4T steel has been used widely in railway axles. Considering the failure behavior of railway axles and other solving methods, laser cladding remanufacturing was used for repairing the railway axles. The microstructure and fatigue fracture mechanism of EA4T steel in laser cladding remanufacturing were investigated by optical microscope (OM), scanning electron microscope (SEM) and X-ray diffraction (XRD). The fatigue life and fatigue crack growth were measured by three-point bending experiments. The microstructure of cladding layers was composed of columnar crystal and fine dendrites, and the main phases of cladding layers were γ and Fe_2B shown by XRD results, which lead to the highest micro-hardness value in the cladding layer. The da/dN-ΔK curves and fracture morphologies indicate that the cladding layers could delay the fatigue crack initiation and improve the fatigue life of EA4T steel.

Keywords: EA4T steel; Laser cladding remanufacturing; Micro-hardness; Fatigue crack growth; da/dN-ΔK curves.

1 Introduction

The railway axles as one of the most important structure in railway system have been applied to bear the dynamic load and the whole weight of vehicle. Therefore, they are subjected to characteristic variable amplitude load, like axial force, radial force, shearing force, bending moment and torsion [1-3]. Therefore, the main failures of railway axle during service are rotary bending fatigue of the axle shaft and fretting fatigue damage of axle pressure surface, which determine the total life of the axles [4]. In order to maintain the safety of railway system, the design of the axles and press fitted joints including optimum dimensions, material selection and surface treatment were