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Abstract

Thermal cracks on the friction surface of railway brake discs can develop during their lifespan. Cracks often initiate after severe braking conditions along with the occurrence of hot spots. The cyclic thermal and mechanical loads causes high temperature, plastic strain and even phase change of the brake disc steel. In this paper, full scale emergency braking tests were conducted and the peak temperature of localized area was found exceeding the austenitizing temperature of the steel. Thermal cyclic tests was performed to simulate the temperature variation during braking. Volume change of the steel caused by microstructure transformation was taken into consideration in numerical simulation. Combining with the fracture behavior of brake disc steel in low cycle fatigue (LCF) tests in different temperature level, the simulation results show a good consistency with the results of microstructure observation and crack initiation. The occurrence of embedded crack could be well explained according to the simulation results and low cycle fatigue test results.

Keywords: brake disc; phase change; thermal fatigue; numerical simulation.

1. Introduction

Brake discs used on railway vehicles are crucial safety components which transform the kinetic energy created during braking into heat by the way of friction. After a period of usage, thermal cracks can be observed on the friction surface of brake discs. During repeated braking cycles, cyclic thermal and mechanical loads were applied on the friction surface[1-3]. For a severe braking condition, plastic strain