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Damage Mechanisms in Silicon-Molybdenum Cast Irons subjected to Thermo-Mechanical Fatigue

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Abstract

The damage mechanisms active in silicon-molybdenum cast irons, namely EN-GJS-SiMo5-1 and SiMo1000, under thermo-mechanical fatigue and combined thermo-mechanical and high-cycle fatigue conditions have been investigated. The studied load conditions are those experienced at critical locations in exhaust manifolds of heavy-vehicle diesel engines, namely a temperature cycle of 300-750 ^oC with varied total mechanical and high-cycle fatigue strain ranges. It is established that oxide intrusions are formed in the early life from which macroscopic fatigue cracks are initiated close to the end-of-life. However, when high-cycle fatigue loading is superimposed, small cracks are preferentially initiated at graphite nodules within the bulk. In addition, it is found that both the oxidation growth rate and casting defects located near the surface affect the intrusion growth.

Keywords: Cast iron, Thermo-mechanical fatigue, High-cycle fatigue, Environmental assisted fatigue, Fatigue crack growth

1. Introduction

The heavy-vehicle automotive industry is constantly subjected to higher demands regarding exhaust emission and power efficiency; the main reason being the progressive restraining in carbon and toxic emission through new

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