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喷射沉积Al-Si/SiC$_p$制动盘材料的热疲劳微裂纹扩展行为

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摘 要：采用V形缺口试样，研究喷射沉积Al-Si/SiC$_p$复合材料制动盘在25~450 ℃热循环下的热疲劳行为。通过金相显微镜和扫描电镜观察了复合材料的组织和热疲劳裂纹形貌，研究热疲劳裂纹形成与扩展机制。结果表明：热疲劳主裂纹主要从V形缺口处萌生；在同样的热循环次数下，热处理前的试样要比热处理后的试样先出现裂纹，且裂纹扩展的速率较快；裂纹绕过Si颗粒向前扩展以及裂纹穿过Si颗粒向前扩展是裂纹与Si颗粒相互作用的主要机制；SiC颗粒与热疲劳裂纹有明显的交互作用。因此，改善Si相的形态和分布以及加强Al/SiC颗粒间的界面结合有利于提高热疲劳裂纹扩展的抗力。

关键字：Al-Si/SiC$_p$复合材料；热疲劳；裂纹形成；裂纹扩展

Small thermal fatigue crack propagation behavior of sprayed Al-Si/SiC$_p$ composite for brake disc

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Abstract: The thermal fatigue (TF) crack propagation behaviors of sprayed Al-Si/SiC$_p$ was studied in the temperature range of 450 ℃ to room temperature using V-notch plate specimens. Optical microscopy (OM) and scanning electron microscopy (SEM) were used to examine the damage mechanism of thermal fatigue. The results show that almost all the primary fatigue cracks at elevated temperatures initiate at V-notch. The crack in test sample before heat-treatment prefers to occur and the crack propagation rate is larger than that of the test sample after heat-treatment. The propagation cracking

around Si particles and through Si particles are the principle mechanisms of interaction between Si particles and crack. The SiC particles play an important role in thermal fatigue cracking. Also, improving the shape and distribution of Si particles and strengthening the Al/SiC interface can improve the resistance of thermal fatigue crack of composites.

Key words: Al-Si/SiC_p composite material; thermal fatigue; crack initiation; crack propagation

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