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论文

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一种球墨铸铁的超高周疲劳行为研究

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Investigation of Superhigh Cycle Fatigue Behavior on Nodular Cast Iron

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摘要

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摘要 应用超声疲劳试验技术,完成了20kHz频率下(R=-1,R=0.1)的疲劳试验,获得球墨铸铁GS51在亿周次范围内的疲劳性能。通过20kHz频率下的超声疲劳试验和35Hz频率下的常规疲劳试验,确定了球墨铸铁GS51在10⁴~10¹⁰周的S-N曲线,并对10⁵~10⁷周之间2种频率下的试验结果进行了比较。试验结果表明,在疲劳循环大于10⁷周时,试件仍会发生疲劳断裂;在10⁷~10¹⁰周之间,疲劳强度随着循环次数的增加而下降。比较10⁷周内20kHz和35Hz下的试验结果,表明超声疲劳试验中,频率对球墨铸铁GS51疲劳性能的影响不大。经扫描电镜观察疲劳断裂试件发现,在高周疲劳条件下,疲劳破坏主要源于试件表面不均匀分布的球墨和试件内部的缩孔。

关键词: 球墨铸铁 疲劳断裂 S-N曲线 超声疲劳试验 缩孔

Abstract: Experiments are conducted to determine the gigacycle fatigue behavior of nodular cast iron GS51 by ultrasonic fatigue test system. Specimens are tested at 20kHz and 35Hz with two different stress ratios (R=-1, R=0.1). The S-N curves at cycles in the range from 10⁴ to 10¹⁰ are obtained. The experimental results shows that fatigue failure can occur over 10⁷ cycles, and that the fatigue endurance stress continues to decrease with increasing cycles to failure between 10⁷ and 10¹⁰ cycles. Comparison of experimental results tested at the frequency either 20kHz or 35Hz shows that there appears no difference on fatigue behavior below 10⁷ cycles. That is, ultrasonic frequency does not evidently affect the fatigue properties of nodular cast iron GS51. Scanning electron microscopy is used to examine the fatigue crack section, it is found that most fatigue cracks initiate from the non-uniformly distributed globular graphites in the subsurface and the voids in the interior of the material.

Keywords: nodular cast iron fatigue crack S-N curve ultrasonic fatigue test void

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