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论文

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含环向裂纹厚壁圆筒电磁止裂的应力场分析

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Analysis of Stress Field in Thick Cylinder with Circular Crack Arrested by Electromagnetic Heating

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摘要

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摘要 以具有轴对称性质、端部带有半埋藏环形裂纹的厚壁圆筒为研究对象,通过对长厚壁圆筒内外环面均匀通入超强脉冲电流进行电磁热止裂。采用复变函数方法求解了脉冲放电瞬间裂纹尖端的温度场和热应力场。在一定的超强脉冲电流作用下,由于环形裂纹尖端的电流绕流热集中效应,裂尖温升超过了金属熔点,使裂尖处金属熔化在内部形成堆焊,钝化了裂尖,并且在裂纹前缘形成了热压应力,阻止了裂纹的扩展。在此基础上还讨论了在电载荷和机械载荷共同作用下裂纹前缘的应力场。

关键词: 半埋藏环形裂纹 止裂 脉冲电流 温度场 热应力场

Abstract: The thick cylinder with half-embedded circular crack is selected as the research object. The crack arrest is accomplished by using electromagnetic heating due to pulse current discharge through the inside and outside circular surfaces. The complex function method is used to solve the temperature field and thermal stress field around the crack tip at the moment when the pulse current is switched on. The small welded joints can be formed at a small sphere near the crack tip inside the thick cylinder by metal melting as a result of heat concentration effect due to the pulse current discharge. The temperature around crack tip raises up instantly and over the melting point of metal. The curvature of the crack end will increase instantly. The thermal compressive stress is around the crack tip. So the formation of the main crack will be prevented. At the same time, the stress field around the crack tip under the action of mechanical load and electrical load is discussed.

Keywords: half-embedded circular crack crack arrest pulse current temperature field thermal stress field

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