

激光与光电子技术应用

激光喷丸范围对小孔构件残余应力场的影响

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摘要: 为了研究不同激光喷丸范围下7050-T7451铝合金小孔构件残余应力场的变化规律, 采用ABAQUS有限元分析软件对激光喷丸过程进行理论分析和数值仿真, 分析了材料激光喷丸后表面及孔壁的残余应力分布。结果表明, 随着喷丸范围的增大, 表面残余压应力范围增大, 冲击区域外围的残余拉应力由52MPa变为344MPa; 孔壁的应力分布随喷丸范围的增加而变差, 中间最差应力由压应力38MPa变为拉应力49MPa; 在一定的喷丸范围内, 激光喷丸范围的增加使表面压应力范围变大而使孔壁应力分布变差。对于激光喷丸强化小孔构件, 应控制喷丸范围, 兼顾板料表面及小孔孔壁的残余应力分布, 以提高小孔构件的抗疲劳性能。

关键词: 激光技术 喷丸范围 残余应力 小孔构件

Effect of laser peening area on residual stress field in small-hole specimens

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Abstract: To investigate the effect of different laser peening area on the residual stress field in a hole specimen of 7075-T7451 aluminum alloy, the process of laser peening and residual stress distribution of the hole specimen were simulated by finite element analysis software ABAQUS. The results show that both the compressive stress of surface residual and the tensile stress of unshocked area increase as laser peening area becomes bigger, the tensile stress of unshocked area changes from 52MPa to 344MPa. The residual stress distribution along inner hole wall turns out to be worse with the increase of laser peening area, the value of the worst stress along the hole inner wall changes from the compressive stress 38MPa to the tensile stress 49MPa. Within a certain range of laser peening area, the increase of laser peening area enlarges surface compressive stress coverage and makes residual stress distribution of inner hole wall worse. For laser peening of a hole specimen, it is important to control laser peening area and the surface residual stress distribution along hole inner wall, in order to improve the fatigue resistance.

Keywords: laser technique laser peening area residual stress hole specimen

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