

激光喷丸成形能力和质量优化及带筋结构约束变形效果

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摘要: 基于有限元法, 模拟了 6005A-T6 铝合金板在激光喷丸多维参数积累作用下的成形能力和成形质量, 获得了整体带筋结构的约束变形效应和成形规律。系统地研究了多维工艺参数对成形能力的影响, 以区分主变量和次要变量。详细地描述了 6005A-T6 铝合金板在超高应变率条件下的动态响应过程和瞬态行为, 并对 LPF 过程中的应力演化过程进行了深入比较和分析。分别研究了整体带筋结构中板结构和立筋结构的约束变形效应和成形规律。结果表明, 工艺参数对弯曲曲率的影响程度依次为激光束直径、激光束能量和喷丸轨迹数。前者可实现大范围整体成形, 后者则更适用于精确变形调整。在 12 道轨激光喷丸过程中, 变形值总体呈上升趋势, 弯曲曲率呈动态趋势。微凹坑的累积效应引起拉压应力耦合, 导致压应力区逐渐向两侧扩展, 且压应力值不断增大。当超过第 7 道时, 压应力值达 300 MPa, 且增量减缓。立筋结构驱动板结构模式可实现双向高效一体化成形, 有利于整体范围粗成形, 而板结构驱动立筋结构模式则更侧重于局部范围的单一方向精确成形。

关键词: 激光喷丸成形; 成形能力; 成形质量; 带筋结构; 约束变形

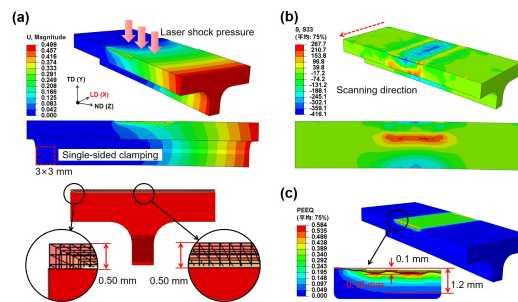


Fig. 1 The panel driving stiffened structure mode of the integral stiffened panel structure. (a), (b) and (c) are the simulation results of deformation field, stress field and equivalent plastic strains after static relaxation, respectively.

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