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微纳技术与精密机械

SiC颗粒掺杂对激光直接成形Al_2O_3陶瓷裂纹敏感性的影响

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摘要： 为抑制激光直接成形Al_2O_3陶瓷过程中的裂纹,利用SiC未熔颗粒的增韧原理,在Ti-6Al-4V合金基底上进行添加SiC颗粒的Al_2O_3同轴送粉激光直接成形实验,分析了激光直接成形Al_2O_3+SiC复相陶瓷的可行性以及成形件裂纹敏感性的影响因素。利用光学显微镜观察薄壁成形试样的裂纹扩展、显微组织和两相结合情况,并使用X射线衍射仪(XRD)进行相分析。结果表明:SiC颗粒可在激光直接成形Al_2O_3+SiC陶瓷中起到抑制裂纹的作用,并可形成各成分结合良好,无明显化学反应,含有较完整SiC未熔颗粒的复相陶瓷材料。单因素实验显示:SiC比例*f*、激光功率*P*、扫描速度*v*和送粉率*n*对裂纹敏感性均有显著影响,最后采用工艺参数:*f* =10%(重量百分比)、*P*=186 W、*v*=300 mm/min及*n*=1.78 g/min成形了裂纹敏感性低,无明显缺陷的长×高×厚约为17 mm×6 mm×2 mm的薄壁件。

关键词： 激光技术 直接成形 复相陶瓷 SiC颗粒 裂纹抑制

Effect of SiC particles on crack susceptivity in laser direct forming Al_2O_3 ceramic

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Abstract: The toughening effect of SiC particles was applied to inhibition of the cracks in Al_2O_3 ceramic for Laser Direct Forming (LDF). The experiments of coaxial laser cladding Al_2O_3 ceramic added SiC particles were performed on the Ti-6Al-4V alloy substrate to investigate the feasibility of Al_2O_3+SiC composite ceramic by LDF and explore the factors effecting on the crack susceptivity. The cracks, microstructures and the combining of the two compositions were observed by an optical microscopy, and the phase transitions were detected by X-ray diffraction. The results show that some complete SiC particles contained in the Al_2O_3 ceramic can inhibit the cracks, and the Al_2O_3+SiC composite ceramic without serious chemical reactions or combining defects can be prepared. The crack susceptivity is significantly affected by the proportion of SiC (*f*), laser power (*P*), scanning velocity (*v*) and the powder flow rate (*n*). Finally, a thin-wall Al_2O_3+SiC composite ceramic block(17 mm?6 mm?2 mm)without the obvious defects was formed with the parameters of *f*,*P*, *v* and *n* in 10%(weight proportion), 186 W, 300 mm/min and 1.78 g/min, respectively.

Keywords: laser technique direct forming composite ceramic SiC particle crack inhibition

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