摘 要

1CrNi2W2MoV 是一种具有较高的室温强度和高温持久强度，良好的韧性及抗氧化性和良好的焊接性的一种新性马氏体耐热不锈钢。因此目前被广泛应用于制造多种航空发动机高温承载部件。激光焊接具有深宽比大、热影响区小、焊接变形小等特点，在工业生产中易实现自动化，在航空构件制造领域得到广泛应用。而激光焊接接头作为航空部件制造中的重要连接技术，接头的质量直接决定着这些航空构件的使用寿命和服役安全。因此本课题对 1Cr11Ni2W2MoV 马氏体耐热不锈钢激光焊接工艺进行研究，寻找得到高质量接头的方法，具有非常重要的意义。

本文用不同焊接速度下的激光焊对 1Cr11Ni2W2MoV 钢板进行焊接，通过对焊接接头宏观形貌的观察和测量、接头显微组织的观察及接头显微硬度的测量对马氏体耐热不锈钢的激光焊接接头的宏观微观组织形貌进行了表征，对接头的力学性能进行了评定，得到了不同焊接速度对接头的成形、微观组织和力学性能的影响规律。

研究结果表明，在 1m/min 到 6m/min 的不同焊接速度下，焊接接头成形良好，焊缝表面没有被氧化的区域，没有焊接裂纹的产生。焊缝的熔深和熔宽随着焊接速度的增大而减小。焊缝区的微观组织全部为晶粒细小板条马氏体组织和高温共晶铁素体，硬度在 647HV 到 660HV 之间。热影响区紧贴熔合线的区域微观组织为板条状马氏体和未转变成马氏体的残留铁素体组织，硬度在 625HV 到 638HV 之间。热影响区中间区域为全马氏体组织，硬度在 638HV 到 647HV 之间。热影响区贴近母材区域组织为比母材软的回火索氏体组织，硬度在 420HV 到 450HV 之间。母材组织没有发生变化为板条状马氏体，硬度在 500HB 到 550HV 之间。

关 键 词：1Cr11Ni2W2MoV；激光焊接；热影响区；微观组织；显微硬度

ABSTRACT

1CrNi2W2MoV is a new martensitic heat-resistant stainless steel with high room temperature strength and high temperature endurance, good toughness and oxidation resistance and good weldability. Therefore, it is currently widely used in the manufacture of high temperature bearing components for a variety of aircraft engines. Laser welding has the characteristics of large aspect ratio, small heat affected zone and small welding deformation. It is easy to realize automation in industrial production and is widely used in the field of aviation component manufacturing. Laser welded joints are an important joining technology in the manufacture of aerospace components. The quality of joints directly determines the service life and service safety of these aerospace components. Therefore, this research on the laser welding process of 1Cr11Ni2W2MoV martensitic heat-resistant stainless steel, looking for a high-quality joint method, is of great significance.

In this paper, 1Cr11Ni2W2MoV steel plate is welded by laser welding at different welding speeds. Laser welding of martensitic heat-resistant stainless steel is carried out by observing and measuring the macroscopic morphology of the welded joint, observing the microstructure of the joint and measuring the microhardness of the joint. The macroscopic microstructure of the joint was characterized. The mechanical properties of the joint were evaluated. The effects of different welding speeds on the formation, microstructure and mechanical properties of the joint were obtained.

The results show that the welded joints are well formed at different welding speeds from 1 m/min to 6 m/min, the weld surface is not oxidized, and no weld cracks are produced. The penetration and width of the weld are reduced as the welding speed increases. The microstructure of the weld zone is all fine grained martensite structure with a hardness between 647 HV and 660 HV. The area of the heat-affected zone that closely adheres to the weld line has a part of ferrite-remaining martensite structure with a hardness of 625 HV to 638 HV. The middle zone of the heat affected zone is a full martensite structure with a hardness between 638 HV and 647 HV. The heat-affected zone is close to the base metal region and is a soft tempered sorbite structure with a hardness of 420 HV to 450 HV. The base metal structure did not change to lath martensite and the hardness was between 500HB and 550HV.

KEY WORDS:1Cr11Ni2W2MoV; Laser welding; Heat affected zone;microstructure ; microhardness

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