

焊接微变形的形成原因分析及测量装置的结构设计

摘 要

随着社会科学不断发展和焊接技术的不断进步，社会需求对应用于机械制造及航空航天领域的焊接零件提出更高的性能要求。但是高强合金的焊接构件通常会由于各种原因产生焊接变形。焊接微变形不仅影响焊件的外形尺寸、疲劳特性还会对构件的力学性能产生影响。因此对焊接变形的测量是提高焊接构件各方面特性的关键问题。本文对焊接变形产生的原因及测量方法进行了分析，设计了以测量和预测焊接变形为目的的三坐标测量仪。论文的主要研究内容如下：

1、从材料、焊接工艺参数、焊接顺序等各方面对焊接变形产生的原因进行分析，最终得到，高强合金焊接构件发生变形的最主要原因是过高的焊接温度使材料晶体组织发生变化、产生残余应力。对已有各种焊接变形测量方法的优缺点进行研究分析，最终提出使用三坐标测量仪测量焊件固有变形，再应用弹性固有变形有限元分析法对焊件变形趋势进行预测。

2、研究分析三坐标测量仪的整机结构特征，主要了解测量仪的各构成系统，重点是设计三坐标测量仪的主机结构。主要对三坐标测量仪的主机部分进行设计计算，同时给出了三坐标测量仪控制及误差分析的基本理论。

3、在设计三坐标测量仪主机部分时，对测量仪整体结构、材料进行了选型；对提高测量精度的关键性导轨、标尺、传动技术进行了分析；对驱动机构、传动系统、测量系统进行了设计计算。最终以 CAD 三维图呈现整个设计结构，得到了能够精准测量焊接微变形的三坐标测量仪。

关键词：焊接微变形，三坐标测量仪，测量精度

ABSTRACT

Because of the development of social science and the tremendous progress of welding technology, the social demand puts forward higher performance requirements for welding parts. Those parts are always used in mechanical manufacturing and aerospace fields. However, the welded members of high strength alloys are usually deformed due to various reasons. The welding micro-deformation not only affects the dimension and fatigue characteristics of the welding parts, but also affects the mechanical properties of the components. Therefore, the measurement of welding deformation is the key to improve the characteristics of welding components. In this paper, we analyze the causes and the measurement means of welding deformation. And in order to measure and predict the welding deformation, we try to design a coordinate measuring instrument. Next, the main point of this paper will be introduced.

1. Based on the analysis of the causes of welding deformation from the aspects of materials, welding process parameters and welding sequence, it is concluded that the main reason for the deformation of high-strength alloy welding members is that the excessive welding temperature changes the crystal structure of the material and generates residual stress. This paper analyzes the advantages and disadvantages of various welding deformation measurement means at home and abroad. Finally, it is proposed to measure the inherent deformation of welding parts with CMM, and then predict the deformation trend of welding parts with finite element analysis of elastic inherent deformation.

2. The whole system structure of CMM is studied and analyzed, and mainly understands the composition of CMM. The key point is to design the main structure of CMM. This paper mainly designs and calculates the main part of CMM, and gives the basic theory of CMM control and error analysis.

3. When designing the main part of the coordinate measuring instrument, the integral structure and material of the measuring instrument are selected. The Air guide rail, measuring stick and transmission technology to improve the measurement accuracy are analyzed. The driving mechanism, transmission system and measurement system are designed and calculated. Finally, the whole design structure is presented by CAD 3d drawing. And we can obtain a coordinate measuring instrument that can measure welding micro-deformation

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