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Effect of preheating on the microstructure and properties of fiber laser welded girth joint of thin-walled nanostructured Mo alloy

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Abstract:

Fiber laser girth welding of a thin-walled nanostructured Mo (NS-Mo) alloy tube was conducted. The microstructures, properties, and residual stresses of the welded girth joints achieved at different preheating temperatures were compared. Combining finite element simulation with experimental data, it was found that as the preheating temperature increased, the maximum welding residual tensile stress monotonically decreased while the tensile strength of the joints increased at first and then declined. At the preheating temperature of 673 K, the tensile strength reached a maximum, which was approximately 50% that of the base metal. The results showed that oxygen content was segregated at the grain boundary of fusion zone during welding and further produced Mo oxides. As the preheating temperature increased, vaporized Mo oxides might escaped from the molten pool, so the oxygen concentration at the grain boundary first decreased. However, when the preheating temperature increased over 773K, the oxygen concentration rose due to the increased oxidation tendency of Mo at high temperatures and grains in the fusion zone coarsened greatly, while the total area of grain boundaries reduced.

Keywords: Nanostructured Mo alloy; girth joint; fiber laser welding; preheating; microstructure; mechanical properties

1. Introduction

Mo alloys are widely used for various parts and structural components at high temperatures due to their excellent mechanical properties [1-3]. Additionally, given the development of aerospace and nuclear industry, the high strength and good formability of Mo alloys are increasingly important [4, 5]. Compared with commercially pure Mo (>99.97% Mo) [6] and

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