Effect of Pulsing Current and Aging Treatment on the Toughness and Precipitation Mechanisms of Weld head for AZ91D Magne

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ABSTRACT

The「Green concepts」are highly emphasized in the worldwide.Therefore, the“ light-weight and recyclable ” materials will be the dominated material in the new century. Among them, magnesium and aluminum alloys are the most representative metals. Up to now, these alloys are not only used in 3C products but also in many other fields.Especially, they are suitable for weight saving construction in the aerospace and vehicle production. Due to the progress in the technetronic generation, consumers seek for the superior quality of products which includes light-weight 、multi-functions 、 high frequency 、electromagnetic interference 、and etc.. As a result, materialize the magnesium alloy become the dominated material in the new generation. However, the HCP crystal structure of magnesium alloy inhibits the low temperature formability, and the techniques of pressing、welding、repairing、forging 、and heat treatment are also not well developed yet. So, the applications of magnesium alloy are temporarily constrained. For manufacturing industries, the welding and heat treatment are the basic and required techniques which are very important to improve the quality of products. Up to now, only few welding papers, which related to magnesium alloy, were reported. Most of them study the welds by laser beam or electron beam machine. In here, we select the most popular welding machine in manufacture industry, gas tungsten arc welding (GTAW), doing this welding research. Hope that the effects on weld microstructure and mechanical properties with different frequency of pulsing current could be revealed. The second stage is trying to convert the high toughness behavior of claw-shaped precipitates from the hard and brittle β phase (Mg17Al12 eutectic phase), which was original forming along the grain boundaries, by aging treatment processes. The precipitation mechanism of precipitates will also be investigated. Based on the experimental results shown that, with increasing the frequency of pulsing current did appear the refined effect on weld structures which would strongly influence the mechanical property and fracture mode. The hardness of welds is all higher than the base metal.The grain size and the mechanical property in 3 Hz pulse weld did show the better performance than other parameters. Hence, the 3 Hz weld was selected to process the following heat treatment, in 420°C solid solution and 200°C ageing treatment. Observing the 200°C、1hr~8hr specimens found that the lamellar precipitates appear in grain boundaries and grow into the grains.Forming this type of precipitate will clearly benefit in micro-hardness and tensile strength. The claw-shaped precipitates begin to precipitate inside the grain uniformly at 16hr aging. Until 32hr, the amount of claw- shaped precipitates increased and the tensile strength, elongation,and toughness also showed the same increasing tendency. It is believed that the claw-shaped precipitate forming is good for the mechanical properties. Hopefully, the results of this study can promote the welding techniques and expand the applications of AZ91D alloy in different fields.

Keywords : AZ91D Magnesium Alloy, Gas Tungsten Arc Welding, Pulsing Current, Aging Treatment, Lamellar Precipitates, Claw-shaped Precipitates

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