The Effect of Aging Precipitates on Mechanical Properties of AZ80A Magnesium Alloy

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ABSTRACT

ABSTRACT Taiwan is one of the most important bicycle suppliers in the world. As a base of production, there must be a mastery of advantages of manufacturing technology. In the respect of the evolution of bicycle materials from early carbon steel, then aluminum alloy, then carbon fiber, and the current titanium alloy, it is apparent that the traders ’ eager desire to find the stronger and lighter materials. Aluminum alloys still dominates the manufacturing of bicycles. The specific gravity of aluminum alloy is about 2.7 g/cm3 and the magnesium alloy is only at 1.8 g/cm3. If product structure size is still remained the same, a use of magnesium alloy can result in 33% reduction of the weight. Not only enjoying low density, magnesium alloy characterized with good specific strength, specific rigidity, machinability, restrict vibration, damping capacity, and recyclability. Aluminum alloy 6061 undergoing T6 treatment has been used frequently in component for bicycles such as frame, handle bar, stem, chain-wheel, seat tube, wheel rim, and brakes. The strength of AZ80A magnesium alloy selected for this experiment is similar to that of T6-treated 6061aluminum alloy that can be extruded, forged and welded and is already used in frame and front-fork. In this experiment, we carried out the tri-temperature aging treatment at 150, 200, 250°C on the extruding AZ80A magnesium alloy, with the aging time ranging from 0.5 hr to 128 hr. We also worked on tensile test, micro-hardness test, x-ray diffraction analysis and analyzing the fracture surface. Hopefully, we can through the implementation of aging process to find the best precipitating mechanism which can enhance the precipitate phase and resilient characteristics for base metal effectively. Findings of the experimental show that the extruding sheet of AZ80A magnesium alloy produces the discontinuous layer-shaped precipitates that grow form grain boundary into interior with short aging time at 150°Ctemperature. These layer-shaped precipitates will continue to increase with the lengthening aging time that brings marked improvement to micro-hardness and ultimate tensile strength but, on the contrary, shows poor influence to elongation. When conducting the short-time aging treatment under 200°C, the generation of layer-shaped precipitates is witnessed, and the amount of precipitates also increase gradually with increasing the aging time. After 8 hours aging, mat-shaped precipitates will be precipitated evenly in untransformed grains, there appears no significant change for yield strength and tensile strength except for a slight decrease of micro-hardness. After 32 hours aging, lath-shaped precipitates precipitated inside the grain, with the meager volume cannot determine the influence of mechanical properties. When conducting under 250 °C, in short aging time specimen, we can observe the discontinuous layer-shaped precipitates and boundary precipitates start to precipitate with the micro-hardness, ultimate tensile strength and elongation to be improved. While at 4hr aging, however, short-rod-shaped precipitates begin to precipitate evenly interior the grain, and boundary precipitates keep growing. Tensile strength and elongation are decreased slowly with increasing the aging time, except the micro hardness is still maintained constant. Our suggestion for thermal treatment of AZ80A magnesium alloy is selecting 200°Caging temperature and 8~16 hr aging time can achieve the better micro-hardness and tensile strength as well as not-so-poor elongation. We expect findings of this research will be helpful to the heat treatment techniques of the bicycle industry and the industry in the hope of making magnesium alloy more extensively applicable in more areas. Key Words: AZ80A Magnesium Alloy, Aging Treatment, Layer-Shaped Precipitates, Mat-shaped Precipitates, Lath-shaped Precipitates, Boundary Precipitates, Short-Rod-Shaped Precipitates.

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