MICROSTRUCTURE MODIFICATION OF MG-AZ92 ALLOY USING A RARE EARTH OXIDE

M. E. MOUSSA[1], S. EL-HADAD[1], WALEED KHALIFA[2]
[1]Department of Casting Technology Central Metallurgical Research and Development Institute
Helwan, Egypt
[2]Cairo University, Faculty of Engineering
Giza, Egypt

Introduction

Magnesium alloys based on Mg-Al system (AZ and AM alloys) are currently receiving considerable attention. These alloys are characterized with their comprehensive properties, such as low density, high specific strength, high damping property, good electromagnetic shielding, excellent machinability and good castability. However, the reduced strength of these Mg alloys acts as problem to exploiting their usage. Many research works aimed at improving the strength of these alloys via modifying their microstructures using chemical modifiers as Ca, Sr or by using rare earth elements such as Y, Eu and etc [1]. In the current investigation, a rare earth (RE) compound; Y_2O_3, was used instead of the elemental Y and its effects on the microstructure modification was studied.

Experimental work

Charges of about 20 kg of commercial grade AZ92 alloy with a nominal composition (in wt. %) of Mg-8Al-2Zn-0.2Mn was prepared as the base alloy for this investigation. Commercial pure Mg was melted to above 650 °C and then Zn was added into the Mg melt. A gas mixture of tetrafluoroethane (CF_3CH_2F, HFC-134a, 1 vol %) and carbon dioxide (CO_2, Bal.) was used for protection. After complete melting, the slag was removed then, a mechanical stirrer by using stainless steel stirrer was introduced into the crucible to create a vortex in the molten alloy at a speed of 600 rpm for 5 minutes. Nominal amounts of Y_2O_3 ranges from 0,0 to 2,5 wt. % were added into the melt vortex in the form of preformed master powder (Al-30 wt. % Y_2O_3). The melt was poured at about 750 °C into a cylindrical sodium silicate-CO_2 sand mould with dimensions of outer diameter (Ø 100 mm), inner diameter (Ø 42 mm) and length (250 mm). The samples were then cut and polished for microstructure observation and mechanical properties evaluation.

Results and discussion

The microstructure shown in fig. 1 indicates the structural modification of AZ92 samples using Y_2O_3. It is clear that without Y_2O_3 addition, the microstructure is coarse dendritic structure. With addition of Y_2O_3, the microstructure was gradually modified. Addition of 2,5 wt. % Y_2O_3 achieved the best combination of tensile strength and elongation, Fig. 2, due to the uniform distribution of Y_2O_3 along the grain boundaries of the investigated AZ92 magnesium alloy matrix.

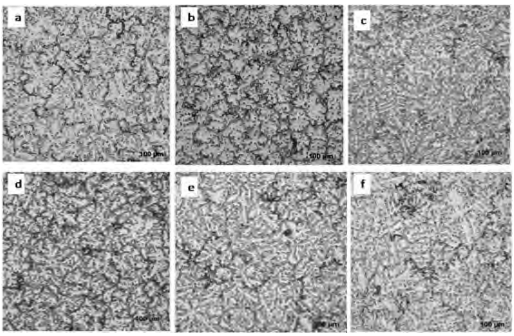

Fig. 1. Microstructure of AZ92: a – 0,0; b – 0,5; c – 1,0; d – 1,5; e – 2,0; f – 2,5 wt. % Y_2O_3

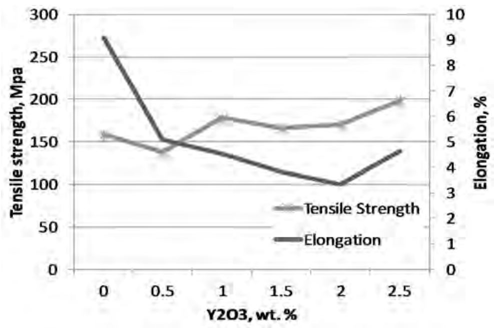

Fig. 2. Tensile properties of the different samples.

Conclusions

AZ92 Mg-alloy can be successfully modified by addition of 2.5wt. % Y_2O_3.

Refrences: Fusheng Pan, Mingbo Yang, Xianhua Chen, J. Mater. Sci. Tech. – 2016. – № 32. – P. 1211–1221.