Review

Current research progress in grain refinement of cast magnesium alloys: a review article

Yahia Ali, Dong Qiu, Bin Jiang, Fusheng Pan, Ming-Xing Zhang

PII: S0925-8388(14)02195-1
DOI: http://dx.doi.org/10.1016/j.jallcom.2014.09.061
Reference: JALCOM 32172

To appear in: *Journal of Alloys and Compounds*

Received Date: 22 June 2014
Revised Date: 1 September 2014
Accepted Date: 7 September 2014

Please cite this article as: Y. Ali, D. Qiu, B. Jiang, F. Pan, M-X. Zhang, Current research progress in grain refinement of cast magnesium alloys: a review article, *Journal of Alloys and Compounds* (2014), doi: http://dx.doi.org/10.1016/j.jallcom.2014.09.061

Current research progress in grain refinement of cast magnesium alloys: a review article

Yahia Ali[1], Dong Qiu[1], Bin Jiang[2], Fusheng Pan[2], Ming-Xing Zhang[1*]

[1] School of Mechanical and Mining Engineering, University of Queensland, St Lucia, QLD 4072, Australia

[2] College of Materials Science and Engineering, Chongqing University, Chongqing, 400030, China

*Corresponding author: Mingxing.Zhang@uq.edu.au

Abstract:

Grain refinement of cast magnesium alloys, particularly in magnesium-aluminium (Mg-Al) based alloys, has been an active research topic in the past two decades, because it has been considered as one of the most effective approaches to simultaneously increase the strength, ductility and formability. The development of new grain refiners was normally based on the theories/models that were established through comprehensive and considerable studies of grain refinement in cast Al alloys. Generally, grain refinement in cast Al can be achieved through either inoculation treatment, which is a process of adding, or in situ forming, foreign particles to promote heterogeneous nucleation rate, or restricting grain growth by controlling the constitutional supercooling or both. But, the concrete and tangible grain refinement mechanism in cast metals is still not fully understood and there are a number of controversies. Therefore, most of the new developed grain refiners for Mg-Al based alloys are not as efficient as the commercially available ones, such as zirconium in non-Al containing Mg alloys. To facilitate the research in grain refinement of cast magnesium alloys, this review starts with highlighting the theoretical aspects of grain refinement in cast metals, followed by reviewing the latest research progress in grain refinement of magnesium alloys in terms of the solute effect and potent nucleants.

1. Introduction:

The lightness, good castability and wealth deposition in the earth, make magnesium (Mg) an attractive and promising structural engineering alloy. Magnesium production have been increased from 670,000 tons in 2007 to 910,000 tons in 2013 [1, 2], being in the third place after steel and aluminium in the world annual production of metals. This indicates that magnesium alloys are in high demanding, particularly, in automotive industry as this sector is working to improve the fuel efficiency through weight reduction [3]. However, Mg alloy is also associated with a number of limitations compared to other metals, such as aluminium alloy. These limitations include low creep resistance, lower tensile properties (strength and ductility), poor workability due to its hexagonal structure, and low wear and corrosion resistance. Generally, surface treatment is an effective approach to solve the wear and corrosion issues [4, 5]. Also, rare earth elements addition is considered as an effective