

论文

铸造Mg-Al-Zn合金的成分、相组成与凝固路径的关系

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摘要:

采用SEM, EDS和XRD研究了Mg-Al-Zn合金的成分、相组成与凝固路径的关系. 结果表明, Mg-Al-Zn合金的相组成与Zn/Al质量比有关; 随着Zn/Al比值的增加, 第二相 $\gamma\text{-Mg}_{17}\text{Al}_{12}$ 的数量减少, 逐渐被 $\phi\text{-Mg}_{21}(\text{Zn}, \text{Al})_{17}$ 取代, 直至完全消失. 通过搜集合金中可能存在的各相的热力学模型, 运用Pandata热力学计算软件平台, 计算并比较了平衡和非平衡(Scheil模型及金属型铸造)条件下合金的成分、相组成与凝固路径的关系. 结果表明, 金属型铸造的凝固过程偏离平衡凝固过程, Scheil模型很好地解释了大多数合金铸造组织的相组成; 但是由于Scheil模型不考虑有固相作为反应物参与的包晶反应, 对ZA65合金凝固路径和相组成的预测结果与实际铸造组织的相组成不符.

关键词: Mg-Al-Zn合金 相平衡热力学 显微组织 凝固路径

RELATIONSHIP OF COMPOSITIONS, PHASE CONSTITUENTS AND SOLIDIFICATION PATHS OF CASTING Mg-Al-Zn ALLOYS

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Abstract:

Casting Mg-Al-Zn alloys are promising for the automotive components loaded under both high strength and high ductility, as well as under high temperatures. The relationship of compositions, phase constituents and solidification paths of casting Mg-Al-Zn alloys were investigated by SEM/EDS, XRD and thermodynamic calculations. It is shown that the phase constituents of Mg-Al-Zn alloys are related to Zn/Al ratio; with the Zn/Al ratio increasing, the secondary phase $\gamma\text{-Mg}_{17}\text{Al}_{12}$ is gradually replaced by $\phi\text{-Mg}_{21}(\text{Zn}, \text{Al})_{17}$ and eventually disappears completely. The phase constituents and solidification paths of the alloys under various conditions, including equilibrium, Scheil and permanent mould casting, were examined by thermodynamic calculation software Pandat with the availability of thermodynamic description of Mg-Al-Zn ternary system. The practical casting process deviates from the equilibrium; however, the practical phase constituents of the experimental alloys except ZA65 can be predicted by the Scheil model. Because of no considering the peritectic reaction in which solid participates as reactant, the Scheil model can not correctly predict the phase constituents of ZA65 alloy under permanent mould casting condition.

Keywords: Mg-Al-Zn alloy phase equilibrium thermodynamics microstructure solidification path

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参考文献:

[1] Friedrich H, Schumann S. In: Aghion E, Eliezer D eds., Proc 2nd Israeli Int Conf on Magnesium Science and Technology. Israel: Dead Sea, 2000: 9

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- [2] Kim J M, Park B K, Jun J H, Shin K, Kim K T, Jung W J. *Mater Sci Eng*, 2007; A449-451: 326
- [3] Vogel M, Kraft O, Dehm G, Arzt E. *Scr Mater*, 2001; 45: 517
- [4] Vogel M, Kraft O, Dehm G, Arzt E. *Scr Mater*, 2003; 48: 985
- [5] Zhang J, Guo Z X, Pan F S, Li Z S, Luo X D. *Mater Sci Eng*, 2007; A456: 43
- [6] Zhang Z, Couture A, Luo A. *Scr Mater*, 1998; 39: 45
- [7] Ma Y Q, Chen R S, Han E H. *Mater Lett*, 2007; 61: 2527
- [8] Andersson J O, Guillermet A F, Hillert M, Jansson B, Sundman B. *Acta Metall*, 1986; 34: 437
- [9] Dinsdale A T. *SGTE Data for Pure Elements*. Teddington, UK: National Physics Laboratory, 1989: 1
- [10] Harding R A, Saunders N J. *AFS Trans*, 1986; 94: 451
- [11] Liang P, Tarfa T, Robinson J A, Wagner S, Ochin P, Harmelin M G, Seifert H J, Lukas H L, Aldinger F. *Therm Acta*, 1998; 314: 87
- [12] Foerster G S. *Proc IMA 33rd Annual Meeting*. Canada: International Magnesium Association, 1976: 35
- [13] Bourgeois L, Muddle B C, Nie J F. *Acta Mater*, 2001; 49: 2701
- [14] Lee J Y, Kim D H, Lin H K. *Mater Lett*, 2005; 59: 3801
- [15] Huang Z H, Liang S M, Chen R S, Han E H. *J Alloys Compd*, 2009; 468: 170
- [16] Liang S M, Chen R S, Blandin J J, Suery M, Han E H. *Mater Sci Eng*, 2008; A480: 365
- [17] Ohno M, Mirkovic D, Schmid-Fetzer R. *Mater Sci Eng*, 2006; A421: 328

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1. 崔传勇, 郭建亭. NiAl-28Cr-5Mo-1Hf多相金属间化合物的显微组织及力学性能研究[J]. *金属学报*, 1999,35(5): 477-481
2. 严有为, 魏伯康, 傅正义, 林汉同, 袁润章. 原位TiC颗粒增强铁基复合材料及其组织形成机理[J]. *金属学报*, 1999,35(10): 1117-1120
3. 王洪斌, 黄进峰, 崔华, 张永安, 熊柏青, 张济山. 喷射成形Al--Zn--Mg--Cu合金的显微组织演变[J]. *金属学报*, 2004,40(8): 0-832
4. 郭巍, 宗亚平, 左良, 王云志. 外加应变对Ti-25Al-10Nb合金显微组织影响的相场法模拟[J]. *金属学报*, 2006,42(5): 549-553
5. 林建国, 吴国清, 魏浩岩, 肖葵, 黄正. γ -TiAl基金属超塑扩散焊接[J]. *金属学报*, 2001,37(2): 221-224
6. 孙坚, 刘润开, 吴建生, 贺跃辉. 1073-1173 K温度范围内TiAl合金的超塑性行为[J]. *金属学报*, 2001,37(1): 95-98
7. 殷凤仕, 孙晓峰, 李耀彪, 于洋, 郑启, 管恒荣, 胡壮麒. 熔体过热处理对M963合金组织和高温持久性能的影响[J]. *金属学报*, 2003,39(1): 75-78
8. 孙晓峰, 殷凤仕, 李金国, 郑启, 管恒荣, 胡壮麒. 一种铸造镍基高温合金的凝固行为[J]. *金属学报*, 2003,39(1): 27-29
9. 赵琳, 张旭东, 陈武柱. 800 MPa级低合金钢焊接热影响区韧性的研究[J]. *金属学报*, 2005,41(4): 392-396
10. 王亚平, 张晖, 丁秉钧, 孙军. 电极材料组织对真空电弧阴极斑点运动行为的影响[J]. *金属学报*, 2004,40(12): 1269-1273