

研究论文

不同路径等通道转角挤压双相Mg--10.73Li--4.49Al--0.52Y合金的组织与力学性能

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摘要: 采用等通道转角挤压(ECAP)工艺在573 K温度下以Bc、A和C三种工艺路径对双相Mg--10.73Li--4.49Al--0.52Y镁锂合金分别进行1--4道次挤压变形, 利用光学显微镜、扫描电镜和X射线衍射等研究变形后合金组织。结果表明, 三种路径ECAP变形后, α 相和 β 相晶粒均得到显著拉长和细化; 4道次变形后, 路径A获得片状晶粒, 路径C获得等轴晶, 而路径Bc获得等轴状和条状相间的组织。室温拉伸实验表明, Bc路径4道次后获得良好的综合力学性能, 其中延伸率达70%。 β 相{110}晶面结构显示, 随着变形道次增加, 三种路径的组织变化存在差异, 但均出现组织软化现象, 对应的抗拉强度也随之降低, 此时组织软化作用大于晶粒细化作用。

关键词: 金属材料 镁锂合金 等通道转角挤压 变形路径 显微组织 组织 力学性能

Microstructure and Mechanical Properties of Two - phase Mg - 10.73Li - 4.49Al - 0.52Y Alloy Processed by ECAP at Different Routes

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Abstract: The extrusion deformation at 573 K was performed on two - phase Mg - 10.73Li - 4.49Al - 0.52Y magnesium - lithium alloy processed by equal channel angular pressing (ECAP) from 1 pass to 4 passes through routes Bc, A and C. The pressed microstructures were investigated by using OM, SEM and XRD. The results show that the grains of both α and β phases are significantly elongated and refined after ECAP deformation with different routes. After 4 passes, flaky grains were obtained for route A, equiaxed grains were gained for route C, and structures alternated with equiaxed and lath - like features were observed for route Bc. The mechanical tensile test at room temperature indicates that route Bc gets good integrated mechanical properties, whose elongation is up to 70%. The texture of {110} crystal plane for β phase reveals that different changes exist among three pressing routes with ECAP passes, but textures of all three routes become softening, therefore the tensile strength decreases correspondingly as the texture softening is more effective than grain refining.

Keywords: metallic materials Mg - Li alloy ECAP deformation route microstructure texture mechanical property

收稿日期 2011-06-23 修回日期 2011-07-19 网络版发布日期 2011-10-25

DOI:

基金项目:

广州市科技支撑计划2009Z2--D811资助项目。

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参考文献:

- [1] Z.Drozd, Z.Trojanov´a, S.K´udela, Deformation behaviour of Mg-Li-Al alloys, *Journal of Alloys and Compounds*, 378(1-2), 192(2004)
- [2] F.R.Cao, H.Ding, Y.L.Li, G.Zhou, J.Z. Cui, Superplasticity, dynamic grain growth and deformation mechanism in ultra-light two-phase magnesium-lithium alloys, *Materials Science and Engineering*, A527(9), 2335(2010)
- [3] J.F.Mason, C.M.Warwick, P.J.Smith, J.A.Charles, T.W.Clyne, Magnesium-lithium alloys in metal matrix composites-A preliminary report, *Journal of Materials Science*, 24(11), 3934(1989)
- [4] KANG Zhixin, PENG Yonghui, SANG Jing, JIAN Weiwei, ZHAO Haidong, LI Yuanyuan, Superplasticity and microstructure evolution in Mg-1.5Mn-0.3Ce alloy deformation by T-shape channel pressing, *Acta Metallurgica Sinica*, 45(9), 1117(2009)
- [5] KANG Zhixin, PENG Yonghui, LAI Xiaoming, LI Yuanyuan, ZHAO Haidong, ZHANG Weiwen, Research status and application prospect of ultrafine grained and/or nano-crystalline metallic materials processed by severe plastic deformation, *The Chinese Journal of Nonferrous Metals*, 20(4), 587(2010)
- [6] I.Balasundar, M.S.Rao, T.Raghu, Equal channel angular pressing die to extrude a variety of materials, *Materials and Design*, 30(4), 1050(2009)
- [7] K.Nakashima, Z.Horita, M.Nemoto, T.G.Langdon, Influence of channel angle on the development of ultrafine grains in equal channel angular pressing, *Acta Materialia*, 46(5), 1589(1998)
- [8] Y.Y.Li, Y.Liu, T.Ngai, D.T.Zhang, G.W.Guo, Effects of die angle on microstructures and mechanical properties of AZ31 magnesium alloy processed by equal channel angular pressing, *Transactions of Nonferrous Metals Society of China*, 14(1), 53(2004)
- [9] LI Xiao, YANG Ping, LI Jizhong, DING Hua, Precipitation behavior, texture and mechanical properties of AZ80 magnesium alloy produced by equal channel angular extrusion, *Chinese Journal of Materials Research*, 24(1), 1(2010)
- [10] A.Yamashita, D.Yamaguchi, Z.Horita, T.G.Langdon, Influence of pressing temperature on microstructural development in equal channel angular pressing, *Materials Science and Engineering*, A287(1), 100(2000)
- [11] Y.C.Chen, Y.Y.Z.Horita, C.P.Chang, P.W.Kao, The effect of extrusion temperature on the development of deformation microstructures in 5052 aluminium alloy processed by equal channel angular extrusion, *Acta Materialia*, 51(7), 2005(2003)
- [12] M.Furui, C.Xu, T.Aida, M.Inoue, H.Anada, T.G.Langdon, Improving the superplastic properties of a two-phase Mg-8% Li alloy through processing by ECAP, *Materials Science and Engineering*, A410-411, 439(2005)
- [13] T.Liu, S.D.Wu, S.X.Li, P.J.Li, Microstructure evolution of Mg-14%Li-1%Al alloy during the process of equal channel angular pressing, *Materials Science and Engineering*, A460-461, 499(2007)
- [14] LIU Teng, ZHANG Wei, WU Shiding, JIANG Chuanbin, LI Shouxin, XU Yongbo, Equal channel angular pressing of a two-phase alloy Mg-8Li-1Al I. Deformation modes during ECAP, *Acta Metallurgica Sinica*, 39(8), 790(2003)
- [15] W.J.Kim, S.I.Hong, Y.S.Kim, S.H.Min, H.T.Jeong, J.D.Lee, Texture development and its effect on mechanical properties of an AZ61 Mg alloy fabricated by equal channel angular pressing, *Acta Materialia*, 51(11), 3293(2003)

- [16] R.Z.Valiev, T.G.Langdon, Principles of equal-channel angular pressing as a processing tool for grain refinement, *Progress in Materials Science*, 51(7), 881(2006)
- [17] XIAO Jimei, *Energetics of Alloys*, The 1st edition, (Shanghai, Shanghai Science and Technology Press, 1985) p.257
- [18] LI Wenxian, *Magnesium and Magnesium Alloys*, The 1st edition, (Changsha, Central South University Press, 2005) p.2
- [19] K.Matsuki, T.Aida, J.Takeuchi, K.Yokoe, Microstructural characteristics and superplastic-like behavior in aluminum powder alloy consolidated by equal-channel angular pressing, *Acta Materialia*, 48(10), 2625(2000)
- [20] K.Nakashima, Z.Horita, M.Nemoto, T.G.Langdon, Development of a multi-pass facility for equal-channel angular pressing to high total strains, *Materials Science and Engineering*, A281(1-2), 82(2000)
- [21] W.J.Kim, H.G.Jeong, Mechanical properties and texture evolution in ECAP processed AZ61 Mg alloys, *Materials Science Forum*, 419-422, 201(2003) 

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2. 马毅斌, 李宁, 黎德育, 张密林, 黄晓梅.Mg-14Li-1Al-0.1Ce合金在卤素溶液(NaX, X=F, Cl, Br和I)中腐蚀行为的研究[J]. *材料研究学报*, 2011,23(6): 467-470
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4. 檀雨默 张爱波 郑亚萍 兰岚 陈伟.具有固-液转变的磁性Fe₃O₄纳米流体的制备、结构及性能[J]. *材料研究学报*, 2011,25(6): 561-565
5. 杨开怀 陈文哲.变形方式对模压变形5052铝合金影响的有限元模拟与试验研究[J]. *材料研究学报*, 2011,25(6): 625-629
6. 齐楠 吴冲沅 张端锋 江垚 贺跃辉.Cu部分代Co超细硬质合金研究[J]. *材料研究学报*, 2011,25(6): 667-672
7. 魏晓玲 杨晖 沈晓冬.TiO₂掺杂对Na-β"-Al₂O₃性能的影响[J]. *材料研究学报*, 2011,25(6): 597-601
8. 邹德宁 陈治毓 韩英 范光伟 张威 .22Cr--5Ni--3Mo--N高合金钢高温变形本构模型研究[J]. *材料研究学报*, 2011,25(6): 591-596
9. 贾涓 代礼斌 袁世来 宋新莉 袁泽喜 柴希阳.P、Ti对高强IF钢{111}面织构的影响[J]. *材料研究学报*, 2011,25(6): 656-660
10. 吴燕飞 黄英 张银铃 牛磊.Me₂--W型钡铁氧体的制备及其电磁性能研究[J]. *材料研究学报*, 2011,25(6): 607-612