

论文摘要

中国有色金属学报

ZHONGGUO YOUSEJINSHUXUEBAO XUEBAO

第17卷 第2期 (总第95期) 2007年2月

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文章编号: 1004-0609(2007)02-0193-07

固溶处理对铸造Al-Si-Cu-Mg合金 组织与性能的影响

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摘要:对固溶处理过程中铸造Al-Si-Cu-Mg合金析出相溶解过程进行了研究。结果表明:在固溶处理初期,组织中 θ 相的数量逐渐减少,但在 $(\text{FeMn})_3\text{SiAl}_{12}$ 相中还有一定的Cu含量;而固溶后期,富铁相中的Cu含量也明显降低,且难溶的 Al_3Ti 针状相也发生钝化,但部分Q相尚存在;随着固溶时间的延长,合金基体中Cu和Mg的含量逐渐增多,且富Mn和富Ti相也在合金基体中略有溶解;合金的固溶强化作用主要来源于富Cu相的溶解。在Al-Si-Cu-Mg固溶处理过程中,合金力学性能的提高主要来源于共晶硅相形貌的改善、析出相溶解引起的固溶强化及组织的均匀化。

关键字: 铸造Al-Si-Cu-Mg合金; 热处理; 析出相; 溶解; 固溶强化

Effects of solution heat treatment on microstructures and properties of Al-Si-Cu-Mg cast alloys

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Abstract: The dissolution of the intermetallic phases was studied and the function of solution strengthening in Al-Si-Cu-Mg casting alloys during solution heat treatment was analyzed. The results show that the θ phase (Al_2Cu) dissolves gradually in the initial stage of solution, but still exists around $(\text{FeMn})_3\text{SiAl}_{12}$ particles until holding time prolongs. In the final stage of solution the needle-like Al_3Ti phases blunt but Q phases ($\text{Cu}_2\text{Mg}_8\text{Si}_5\text{Al}_4$) still exist. With the solution time prolonging, the amounts of Cu and Mg atoms in matrix increase, and Mn and Ti intermetallics dissolve partly. However, the function of solution strengthening mainly originates from Cu atoms. The increase of mechanical properties of alloy during solution heat treatment are due to the combined effect of dissolution of the intermetallic phases, uniformity of structure and spheroidization of silicon particles.

Key words: Al-Si-Cu-Mg cast alloy; heat treatment; intermetallic phases; dissolution; solution strengthening

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