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纤维及界面反应对mullite/Al-4.0Cu-1.85Mg 铝基复合材料时效行为的影响

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摘要: 采用挤压铸造方法制备mullite/Al-4.0Cu-1.85Mg铝基复合材料, 用硬度测试(HB)、差示扫描量热仪(DSC)和分析透射电镜(ATEM)等手段, 研究了复合材料及其基体合金的时效硬化特性、时效相的析出序列、析出相和位错的微观形貌特征以及界面结构。结果表明: mullite纤维的引入抑制了GPB区的形成, 提高了基体合金的时效硬度, 但纤维加速复合材料时效硬化的作用不明显。这是由于Mg元素在纤维/基体界面处发生了界面反应, 生成镁铝尖晶石($MgAl_2O_4$), 使复合材料中非纤维区内实际Mg含量降低所致。

关键字: mullite纤维; Al-Cu-Mg合金; 时效; 位错; 界面反应

Effects of fibres and interfacial reactions on ageing behaviour of short mullite fibre reinforced Al-4.0Cu-1.85Mg composite

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Abstract: Short mullite fibre reinforced Al-4.0Cu-1.85Mg composite and unreinforced monolithic alloy were fabricated through squeeze casting route. The age-hardening behaviour, precipitation procedure, microstructure of dislocation and precipitates and the interfacial structure have been studied by means of hardness measurement(HB), differential scanning

calorimetry (DSC) and analytical transmission electron microscope(ATEM), respectively. It is found that short mullite fibre in the composite induces high dislocation density in the near vicinity of the interface after solutionized and ice-water quenched, suppresses or delays the formation of GPB zones. The aged hardness of the composite is always higher than that of the monolithic alloy, but there appears little difference between the times needed in the composite and in the monolith to reach the peak hardness, which means that the acceleration effect of mullite fibre on the precipitation of Al-Cu-Mg alloy is not great enough. It is also found that Mg reacts with Al and SiO₂, resulting in the formation of spinel(MgAl₂O₄), hence depleting Mg in the matrix and finally hindering the ageing acceleration in the testing composite.

Key words: mullite fibre; Al-Cu-Mg alloy; ageing; dislocation; interfacial reaction

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