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Cu-Ag合金原位纤维复合材料的应变强化效应

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摘 要：制备Cu-10Ag和Cu-10Ag-Ce合金原位纤维复合材料，研究结构变化与应变强化的关系。随着真应变增大，复合材料中的Ag纤维平均尺寸呈真应变的负指数函数减小，而极限强度呈真应变的指数函数增大。按其结构变化，原位复合材料显示两种强化机制：低应变阶段主要为加工硬化机制，高应变阶段主要为超细Ag纤维及界面强化机制。增大凝固速率和添加微量Ce明显细化合金的初始Ag相和Ag纤维尺寸，增高原位纤维复合材料的应变强化速率。在真应变为10.4时，缓慢、快速凝固Cu-10Ag合金和Cu-10Ag-Ce合金原位纤维复合材料的Ag纤维平均直径分别为140、90和80 nm，极限拉伸强度分别为1 250、1 370和1 430 MPa。

关键字： Cu-Ag合金；复合材料；强化效应；Ce添加剂

Strain strengthening of Cu-Ag alloy in situ filamentary composites

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Abstract: Cu-10Ag and Cu-10Ag-Ce alloys in situ filamentary composites were prepared. The relationships of the ultimate tensile strengths (UTS) and microstructure evolution of the filamentary composites were studied. With increasing true strain, the sizes of Ag filaments in the composites decrease according to a negative exponential function of the true strain. The UTS of the composites increase also according to a exponential function of the true strain. The two-stage strengthening mechanisms were discussed on the evolution of microstructure during deformation process: at low true strain stage, the strengthening mechanism is mainly one caused by the working hardening controlled by dislocation increasing; at high true strain stage, the strengthening mechanism is mainly one caused by the super-fine Ag filaments and large coherent interfaces between Ag filaments and Cu matrix. The rapid solidification and trace Ce addition in the alloys obviously refine the sizes of original Ag precipitate in cast alloys and Ag filaments in the in situ composites, and therefore obviously increase the strain strengthening rate of the Cu-10Ag alloy in situ filamentary composites. As the true strain is 10.4, the average size of Ag

filaments are about 140, 90 and 80 nm, and the ultimate tensile strengths are 1 250, 1 370 and 1 430 MPa in the Cu-10Ag alloys solidified slowly or rapidly, as well as in Cu-10Ag-0.05Ce alloy, respectively.

Key words: Cu-Ag alloy; composite; strengthening effect; Ce addition

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