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急冷条件下Cu-Sn合金的快速枝晶生长

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摘 要：研究快速凝固Cu-*x*Sn(*x*=7%，13.5%，质量分数)合金的相结构、组织形态和枝晶生长特性，将金属熔体热传导方程与Navier-Stokes方程相耦合，从理论上计算液态合金的冷却速率。结果表明：在急冷快速凝固条件下，Cu-7%Sn合金形成过饱和的单相*a*-Cu固溶体组织；Cu-13.5%Sn合金形成以亚稳的$Cu_{13.7}Sn$相为主相、*a*-Cu为第二相的快速凝固组织；随着冷却速率的增大，溶质截留效应增强，合金相结构由复相向单相转变；沿垂直于辊面方向上合金的组织形态依次为近辊面细小等轴晶、中部柱状晶及自由面粗大等轴晶；增大冷却速率，晶体形态由柱状晶向等轴晶转变；在急冷快速凝固过程中，*a*-Cu和$Cu_{13.7}Sn$相均以枝晶方式生长；随温度梯度的增大，晶体生长速率呈线性增大。

关键字： Cu-Sn合金；单辊法；急冷快速凝固；晶体生长

Rapid dendritic growth in melt-spun Cu-Sn alloys

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Abstract: The phase structure and microstructural characteristics of rapidly solidified Cu-xSn(x=7%, 13.5%, mass fraction) alloys were investigated. The cooling rate was calculated theoretically by coupling the heat conduct equation and Navier-Stokes equation. The results show that under rapid solidification condition, the single phase a-Cu solid solution is formed in Cu-7%Sn alloy. The microstructure of Cu-13.5%Sn alloy consists of main phase Cu13.7Sn and a few of a-Cu phase. With increasing cooling rate, the effect of solute trapping is enhanced, and the phase structure changes from multiphase to single-phase. The microstructures of the alloy along the direction vertical to wheel surface are characterized by fine equiaxed, columnar and coarse equiaxed grain, respectively. Both a-Cu and Cu13.7Sn phase grow in the manner of dendritic growth. With increasing temperature gradient, the growth rate of columnar crystals increases linearly.

Key words: Cu-Sn alloy; melt-spun method; rapid solidification; crystal growth

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