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论文

Si粉表面溶胶-凝胶预处理制备Cu/Si复合材料

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摘要:

以Si粉在Al_2O_3/TiO_2复合溶胶中预处理形成的凝胶膜层作为扩散阻挡层抑制Cu-Si反应, 制备出Cu/Si复合材料, 研究了Cu/Si 复合材料的相组成、显微结构与性能.结果表明: Si粉预处理的Cu/Si复合材料主要由Cu和Si组成, 含有少量的Cu_3Si相; 其硬度为147HV0.1, 室温热扩散系数为26.4 mm^2/s. 复合材料烧结过程中Cu原子与Si原子借助膜层中的缺陷部位进行扩散, 在Cu/Si界面局部反 应形成Cu-Si化合物. 相比之下, Si粉未预处理的Cu/Si复合材料只含有Cu_3Si相, 无Cu与Si残留; 其硬度高达399HV0.1, 室温热扩散 系数仅为3.0 mm^2/s. 所以, Si粉表面溶胶--凝胶预处理可以有效降低Cu-Si反应程度, 保持复合材料中的Cu相与Si相, 提高导热性能.

关键词: Cu/Si复合材料 溶胶-凝胶 热扩散系数 扩散阻挡层

FABRICATION OF Cu/Si COMPOSITES ON SOL–GEL PRETREATED Si POWDERS

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Abstract:

Cu/Si composite is an ideal material for electronic packaging owing to its excellent thermophysical and mechanical properties. Especially, its high thermal conductivity can fulfill the requirements of quick elimination of heat of high power devices. However, because of the severe diffusion and reaction between Cu and Si, the Cu–Si compound replaces the Cu and Si phases during the powder metallurgy fabrication at elevated temperature. Therefore, the crucial issue of Cu/Si composite fabrication is to control the Cu–Si diffusion and reaction. In this paper, the Cu/Si composites were fabricated using pretreated films on Si powder formed in Al_2O_3/TiO_2 sol as a diffusion barrier to prevent Cu–Si reaction. The phases, microstructures and properties of Cu/Si composites were investigated. The results indicate that Cu/Si composites on which Si powders are pretreated by sol–gel are primarily composed of Cu, Si, and a few Cu_3Si phases. The hardness of the composite is 147HV0.1, and the thermal diffusivity at room temperature is 26.4 mm^2/s. Cu and i atoms diffuse via. the defects ifilm and react to form Cu–Si compound in local regions at Cu/Si interface during sintering. However, oly Cu3Si phase is detected in the composite on which the Si powder s not pretreated, and no Cu or Si trace is found. The hardnss is as high as 399HV0.1, but the thermal diffusiviy at room temperature is only 3.0 mm^2/s. Thrfore, sol–gel pretreatment on Si powders can effecively reduce the Cu–Si reaction and protect the Cu and Si phases in composites so as to elevate the thermal conductivity.

Keywords: Cu/Si composite sol-gel thermal diffusivity diffusion barrier

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