Novel Coating of Porous Cu as Heat Pipe for Thermal Management

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With computers and smartphones rapidly upgrading their capacity and processing speed, cooling using heat pipes has become increasingly important to protect fragile electrical components from excessive heat. Porous copper is an effective wick material in heat pipes due to its great thermal conductivity, high surface area and great capillarity for fluid transport. However, the current fabrication method, sintering, has drawbacks of high energy input, and the possibility of damaging prefabricated components, limiting the range of electronics devices it can apply to. In this work, a novel electroplating method in producing a highly porous multilayer copper structure is proposed for the first time. By applying overpotentials of above 1 V and extending electroplating durations, intense hydrogen gas evolution is triggered alongside copper deposition to create a honeycomb-like porous structure. The effect of different combinations of overpotentials and durations on the morphologies of copper deposits is investigated. Characterization is done via scanning electron microscope, and vertical wicking tests are conducted to determine the capillarity of structures obtained. Findings show that the combination of 3 V and 120 s produces a highly regular and interconnected multilayer porous structure which exhibits excellent water wicking performance, significantly better than coatings of lower porosity and thickness. Electroplating is therefore a viable and promising option to fabricate high-performance heat pipe copper wicks, especially when electronics demand greater heat transfer capacity but offer increasingly limited space. Additionally, preliminary findings from this work suggest that future work may include strengthening the multilayer structure using overpotentials of below 1 V.

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