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Influence of Spark Plasma Sintering parameter on Cu-CNT composites for thermal management

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Abstract content
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As technological development is advancing towards increasing chip performance with continuous downscaling of complementary metal oxide semiconductor (CMOS) devices, power density has posed a challenge for advanced electronic system. Thermal management in the electronics package has become the major concern in the development of the microelectronic components. The purpose of thermal management devices is to cool the hotter integrated circuit component by dissipating the heat which is then conveyed out of the assembly by air to avoid overheating.

Copper reinforced with carbon nanotube has emerged as a material of choice for thermal management due to its attractive properties such as high thermal conductivity (400 W/m-K Cu and 3000 W/m-K carbon nanotubes (CNTs)), low coefficient of thermal expansion (CTE) of approximately zero for CNTs and ease of fabrication of copper powders. However, achieving a homogenous distribution of CNT in Cu matrix without damaging the CNT is still a challenge. In addition, achieving full densification of the feedstock powder is also a challenge due to the oxidation of copper at room temperature. The aim of this study is to develop an improved method of fabricating Cu-CNT composite with good densification without damage to the nanotube in the Cu matrix using Spark Plasma Sintering (SPS) technique. In this study, 1 and 2 vol% multiwalled CNTs were dispersed into sub-micron sized copper powders using a mechanical stirring technique, and the admixture was annealed and sintered using SPS at 600 and 650oC with a pressure of 50 MPa.

The microstructure of the sintered sample was investigated using high resolution scanning electron microscopy (HRSEM). Raman spectroscopy was used to differentiate the CNTs from pores since both appear black on a SEM image. Density, porosity, thermal conductivity will be measured to evaluate the performance of the sintered samples.

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Level for award
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PhD

Main supervisor (name and email)
and his / her institution

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