Copper-based MMC´s for Thermal Management of Electronic Devices

T. Weissgaerber, T. Schubert, H. Weidmueller, B. Kieback

Fraunhofer-Institute for Manufacturing and Advanced Materials,
Powder Metallurgy and Composite Materials,
Winterbergstr. 28, D-01277 Dresden, Germany

Thermal aspects are becoming increasingly important for the reliability of the electronic components due to the continuous progress of the electronic industries such as the higher output power and the higher level of integration of ICs. To achieve long life and reliable performance of these components, it is necessary to keep the operating temperature of the electronic device within specified limits. Therefore, the effective thermal management is a key issue for packaging of high performance semiconductors. It can be realized by active or passive cooling methods. In the case of passive cooling materials working as heat sink and heat spreader should have a CTE of 4-8 ppm/K and a high thermal conductivity. This paper will review our recent developments of copper matrix composites reinforced with diamond, graphite or SiC in order to obtain a composite material having a thermal conductivity higher than 400W/mK in case of copper/diamond and copper/graphite or higher than 300W/mK in case of Cu/SiC. The Cu-based composites were fabricated by a powder metallurgical method (powder mixing with subsequent pressure assisted consolidation). In order to design the interfacial behaviour between copper and the reinforcement different alloying elements were added to the copper matrix. The thermo-physical properties will be displayed and discussed as a function of the reinforcements as well as the alloying elements used for composite preparation.