**Synergetic effect of discontinuous carbon fibers and graphite flakes on thermal and thermo-mechanical properties of aluminum matrix composites**

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Many carbon reinforced metal matrix composites are currently used in several applications. One of them concerns their use as heat sinks in microelectronics. Concerning this application, two conditions are required: a high thermal conductivity (TC) and a coefficient of thermal expansion (CTE) to match the materials used in the electronic device. Currently Cu or Al heat sinks are being used, however, they are not suitable due to their large CTE mismatch with the ceramic and silicon parts of the component. Such differences in CTEs cause thermo-mechanical stresses at the interfaces and result in the components failure after several ON/OFF cycles.

Several studies offer to replace Cu and Al heat-sinks by metal matrix composites (MMCs) particularly with carbon reinforcements. By combining the high TC of both entities and their drastically different CTEs, one can expect to obtain a thermally efficient material with adaptive properties.

Compared to the others matrices (copper or silver), aluminum has a chemical affinity with carbon, a low density and price, and offers a great advantage in terms of fabrication of mobile electronic devices in automobile or aeronautic industries.

In this study Aluminum/Carbon composite materials were prepared by vacuum hot pressing. Two carbon reinforcements were used: Graphite flakes (GF) and Carbon fibers (CF). Graphite flakes provide an increase of TC while conserving the Al’s CTE in the direction of the reinforcements. In contrast, carbon fibers provide a decrease of the CTE with a percolation threshold between 20 and 30 vol.% of FC, while conserving Al’s TC.

Al/(GF+CF) composite materials Al/(GF+CF) fabricated with a mixture of two reinforcements show the same behavior than Al/GF composites with the same graphite flake contents, but differ from Al/CF composites with the same carbon fibers contents. Indeed, Al/(GF+CF) composites show a significantly lower CTE than Al/CF composites which can be attributed to a synergy between GF and CF. Tomography X analyses show the formation of a carbon network made of carbon fibers and graphite flakes which explains the lower CTE of Al/(GF+CF). Besides the increase of TC, the GF allow decreasing the percolation threshold of carbon fibers.