Formation of Complex, Three-dimensional, Metallic Components Through a Removable-template Electroplating Technique

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In general the cooling needs of small electronic components are met with passive heat sinks (elements with a high thermal conductivity and high surface area) or with forced air-cooling. Central processing units (CPUs) in computers presently require combinations of both passive heat sinks and forced air-cooling in order to dissipate rather large amounts of heat from a small surface area. However, the trend is towards more powerful CPUs which will require either more powerful fans, which are undesirable due to the increased noise and cost, or active heat-exchange devices.

A schematic representation of a heat-exchange system is shown in Fig. 1, where the component to be fabricated is denoted as "back end". A liquid is heated in the front end, which is in good thermal contact with the device to be cooled ("heat source"). The heated liquid is then circulated by means of a small pump to the back end where the heat is transferred to a stream of air produced by a fan. The back end and fan assembly may be located remotely from the heat source in order to minimise noise and heat pollution of the immediate environment.

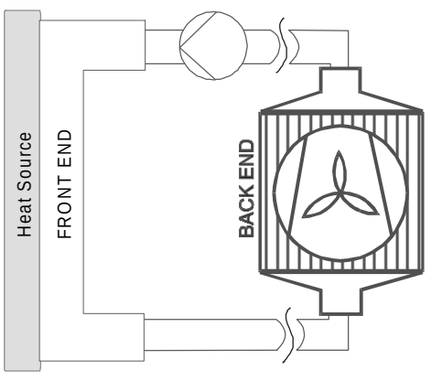

Fig. 1 - schematic representation of a heat exchanger system for electronic components

The approach adopted here to form the back ends was to start with a polymeric template which was then copper-plated and the template removed. However, as the polymer was electrically insulating a conducting layer was required. Several different approaches to forming a conducting layer on the polymer surface will be discussed and contrasted. The approaches included electroless metal deposition, graphite coating and carbon black deposition.

A second point of interest in the back end formation was the method of removal of the template. Clearly an optimal process would produce no environmentally undesirable side products, be fast and not unduly stress the copper structure. Dissolution and thermal removal of several polymer templates as two alternative methods were examined and will be discussed.

Although the target structure considered here was to be used in a heat exchange system the concept would lend itself readily to other microsystems requiring hollow metallic bodies, including microreactors. In contrast to classical, mechanical engineering techniques metallic structures with complex geometries were prepared without having to fuse parts together, Fig. 2.

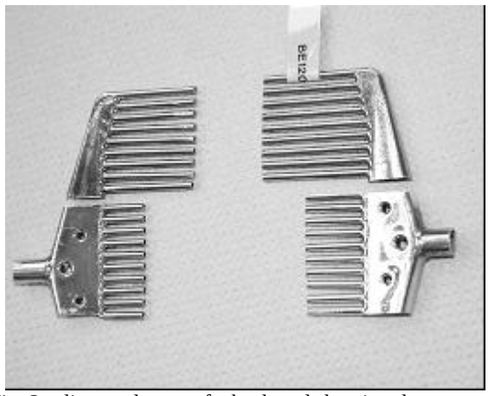

Fig. 2 - dissected parts of a back end showing the range of geometric components that may be included in a single structure