

## **Supply and availability of novel high thermal conductivity materials**

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Electronics cooling by high thermally conductive heat spreader and heat sink materials is currently in direct competition with established materials e.g. copper on the one hand and active solutions e.g. heat pipes and liquid cooling on the other hand.

The availability of advanced materials such as carbon-metal composites strongly depends on managing the interface between the metal matrix (Cu, Al, Ag, etc) and the typically carbon based reinforcement (fibres, tubes, diamond, carbides, etc) and on developing a suitable and economically feasible production process.

Despite intensive sampling and qualification activities, no diamond, carbon nano tube or carbon fibre based product is in serial consumer electronic application as of today. The development of materials has continued through the past 10 years. Customer specific design, modelling and implementation into packages have been demonstrated several times. Presently the development of a diamond composite with tailored design features takes approximately 8-12 weeks with an additional qualification phase of another 6-12 months. Faster introduction and realization is limited by the knowledge of thermal engineers about the extraordinary characteristics of diamond-metal composites. Product releases and upgrades generally represent the best time for introduction of new materials into established production lines. Market introduction of novel materials hence depends on the life cycles of product generations.

Enhanced thermal performance is accompanied by an increase in price of the heat spreader. The individual overall performance to cost ratio is also defined by the influence of the thermal performance on speed, reliability and product life time.

Plansee has established an integrated production line for diamond composites encompassing all steps from quality control of the raw materials to coating and final inspection of the finished product. Capacities of such integrated lines range up to several thousand pieces per week depending on form factors and can furnish an entire product generation. Al- and Cu-based diamond composites especially designed for the power electronics industry are presented, representing only one aspect of the business portfolio the others being opto- and micro electronics.