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Improving thermal conductivity in polymeric composites is a global goal because of the possibility to replace metallic materials in thermal applications. Polymeric matrix composites could bring to a significant weight reduction with respect to metals, and also to an improvement of corrosion resistance and easier processability at low temperature.

Unfortunately there are many issues related to obtaining good thermal conductors using a polymeric matrix. Indeed, the polymeric intrinsic phonon dumping nature does not allow to fully exploit the high conductivity of the fillers. This is particularly evident in graphene-based composites, where high graphene fractions are needed to obtain only discrete thermal conductivity improvements.

Among the strategies that can be used to reduce the damping effect of the polymeric matrix on the thermal conduction, one is the preparation of a continuous network of graphene as the phonon-carrying-agent

In this work a self-standing 3D graphene oxide structure was prepared by hydrothermal means and infiltrated with a thermoset polymer, in order to create a composite with a preferential path for phonon transfer. The infiltration process brings to a dense composite, and does not modify substantially the graphene network structure.

The porosity of the 3D graphene network was demonstrated to be tunable by a convenient choice of the preparation parameters. This allows to tailor the filler to matrix ratio and the size of the pores. Moreover, the surface properties of the network can be altered, for instance by heat treatment, aiming at the maximization of the composite thermal properties.

The thermal properties were verified by hot disk and laser flash techniques, and samples were prepared that allowed to compare the effect of a graphene 3D network with a standard graphene dispersion. It was demonstrated that a concentration as low as 1% of graphene can double the thermal conductivity of the polymer.