Graphene-coated hollow silica microspheres and their use as conductive fillers for plastics

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Abstract

Graphene is one of the most promising materials in materials science due to its intrinsic properties. It is an emergent product that leads to a profound impact in many fields of industry. Graphene is a two dimensional carbon allotrope, which is a one-atom-thick sheet of carbon atoms in a hexagonal arrangement. It has a record thermal conductivity of about 5000 $W.m^{-1}.K^{-1}$ at room temperature, an extremely high specific area (theoretical value of 2630 $m^2.g^{-1}$), a high intrinsic mobility (200,000 $cm^2.v^{-1}.s^{-1}$), a unique Young's modulus (~ 1.0 TPa) and a remarkable optical transmittance (97.7%).[1-2] Because of these unique characteristics, graphene can be considered as a good choice to combine with particles of interest in order to promote certain properties. Indeed, the addition of graphene on top of silica nano- or microparticles, could increase the silica surface functionality and the tunability of its properties.

Materium Innovations Inc. has recently developed graphene-silica materials based on the coating of hollow silica microspheres with graphene layers using a chemical grafting process or a plasma deposition process (Figure 1). Both processes afford ultralight multifunctional composite materials (density about 0.1-0.2 g/cm^3) with interesting thermal and electrical properties. According to preliminary results, an addition of 4% wt. of Materium graphene-coated silica hollow microparticles in an epoxy resin gives rise to an electrical resistivity of 0.10 Ω.cm (or an electrical conductivity of 10 $S.cm^{-1}$). Merging the weight-lightening properties of the hollow silica microspheres with the graphene as a thermal and electrical conductive material makes Materium's product a good candidate for the use as a conductive filler for polymers.

References

[1]. Science **2015**, *347*, 1246501.
[2]. Nature **2006**, *442*, 282.

Figures

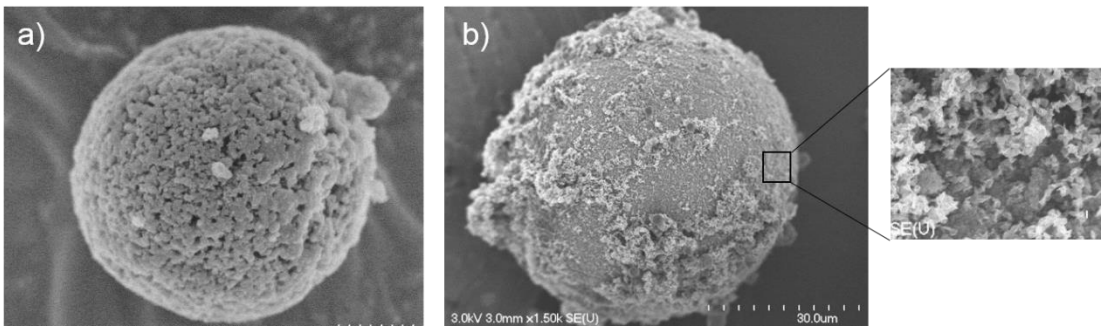

Figure 1: SEM images of a) a silica microcapsule and b) a silica-graphene microparticle produced using plasma deposition process