Development of graphene-coated hollow silica microspheres and their use as conductive fillers for polymers

Dietrich Bodecker, Cé Guinto Gamys and Mathilde Gosselin

Materium Innovations Inc., 790 Boulevard Industriel, Granby, Quebec J2G 9J5, CANADA
dbodecker@materium.ca

Abstract

Due to their unique physicochemical properties, carbon allotropes have emerged as novel materials apt to have a profound impact in many specialty applications. As an example of carbon allotrope, graphene, which is a one-atom-thick sheet of carbon atoms in a hexagonal arrangement, 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] In this regard, graphene can be considered as a template of choice for the assembly of particles of interest on its surface. Indeed, the decoration of graphene with specific compounds and structures, such as silica nano- or microparticles, could increase its 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 0.2-0.3 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 ohm-cm (or an electrical conductivity of 10 $S.cm^{-1}$). The resulting materials can be used in numerous applications including electronics, electrochemistry, solar cells, battery, RF cables, etc.

References

[1]. Macromolecules 2010, 43, 6515–6530
[2]. Nature 2006, 442, 282-286

Figures

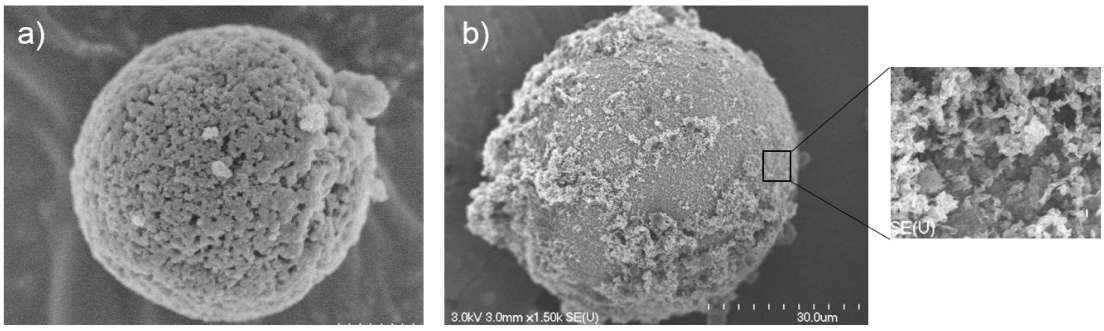

Figure 1: SEM images of a) a silica microcapsule and b) a silica-graphene microparticle produced using plasma deposition process