Electrical Characterization of polymer matrix graphene composites

Imanol Recio[a,b] Julio Gomez[a] Elvira Villaro[c,d]

a) AVANZARE, Avda. Lentiscares 4-6, Navarrete, Spain; b) Departamento de Químicas. Universidad de La Rioja, Madre de Dios, 53 Logroño, Spain; c) Instituto de Tecnologías Químicas Emergentes de La Rioja; San Francisco, 11 Navarrete, Spain; d) Departamento de Química Inorgánica y Técnica, UNED. Senda del Rey, 9, Madrid, Spain.
irecio@avanzare.es

Abstract

Nanocomposites are high performance materials that exhibit unusual properties and thus are of high interest in material science. Carbon based materials have been widely used as reinforcements in polymers. Several authors have used graphene as filler in different polymer matrix (olefin, acrylic, styrene, polyurethane and vinyl) showing important improvements in electrical, thermal and mechanical properties. Factors as processing technique, dispersion and compatibility between graphene and matrix have an extremely high importance in the results.

This poster deals on the electrical characterization of 2D nanocomposites. Some reduce graphene oxide has been prepared and characterize.
The reduce graphene oxides, with different lateral size, thickness and defects, have been combined with different polymer matrices (PVC-plastisol, epoxy-resin, Polyamide 6 and TPU) to obtain a series of nanocomposites. Electric impedance spectroscopy (EIS) is the technique used to characterize electrically these nanocomposites and analyse the dielectric relaxations of these composites.

Very low percolation loads have been reached appreciating conductivity in composites with load as low as 0,13%w. in TPU composites or 0,3%w in epoxy-resin composites. The effect of temperature has been studied seeing a very high increase of the electrical conductivity with the temperature. The conductivity mechanism and the effect of the humidity in function of the temperature has been also studies.

References and acknowledgements

[1] Cunningham G, Lotva M, McEvoy N, Duesberg GS, Van Der Schoot P and Coleman JN. 2012. Percolation scaling in composites of exfoliated MoS2 filled with nanotubes and graphene. Nanoscale, 4, 6260-6264

[2] Khanam P N, Ponnamma D and AL-Madeed M A 2015 Electrical Properties of Graphene Polymer Nanocomposites Graphene-Based Polymer Nanocomposites in Electronics (Springer Series on Polymer and Composite Materials DOI 10.1007/978-3-319-13875-6) pp 25–47

[3] Galindo B, Gil Alcolea S, Gómez J, Navas A, Ortega Murguialday A, Pérez Fernandez M and Puelles R C 2014 Effect of the number of layers of graphene on the electrical properties of TPU polymers IOP Conf. Ser.: Mater. Sci. Eng. 64 012008 http://dx.doi.org/10.1088/1757-899X/64/1/012008

[4] Liao K H, Qian Y, Macosko C W 2012 Ultralow percolation graphene/polyurethane acrylate nanocomposites Polymer 53 3756–61

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie Grant Agreement no. 642890 www.thelink-project.eu