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Study of the Influence of Surfactant Nature and Concentration on the Electrical Properties of Natural Rubber/Expanded Graphite Nanocomposites

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Extended Abstract

Graphene is an allotrope of carbon in which the carbon atoms form a honeycomb crystal lattice. Graphene presents high thermal conductivity, electrical conductivity and excellent mechanical properties and can be obtained from graphite by different methods such as micromechanical exfoliation (Novoselov et al., 2004), ultrasound treatment (Puangbuppha et al., 2012), chemical or thermal exfoliation of graphite oxide (Zhu et al., 2010) or chemical vapor deposition (CVD) (Bo et al., 2013). Graphene has been used in the development of electrically conductive polymeric nanocomposites (Stankovich et al., 2006). However, graphene tends to form agglomerates when dispersed in polymer matrices. An attractive alternative is the mixing of the polymer in the form of latex with the graphene aqueous suspension. The use of surfactants could result in obtaining stable aqueous suspensions of graphene, however, the nature and the structure of the surfactant may affect the final properties of the composite (Tkalia et al., 2012).

Here we report the preparation and electrical properties of natural rubber (NR)/expanded graphite (EG) nanocomposites. The EG was prepared by thermal expansion of graphite oxide obtained by the method described by Brodie. The preparation of the composites were carried out by mixing natural rubber latex with aqueous suspensions of EG in different surfactant solutions such as sodium dodecylsulfate (SDS), dodecyltrimethylamonium bromide (DTAB), Triton X-100 and Pluronic F 127. The influence of the nature and concentration of the surfactants on the electrical properties of the composites were evaluated. The concentration of the surfactants was varied starting from below critical micelle concentration (0.5 CMC), at CMC and above CMC (1.5 CMC).

Compsites prepared with the same EG content but using different surfactant showed very different electrical resistivities. Nanocomposite prepared by using DTAB (1.5CMC) displayed the lowest resistivity (3.66E+05Ohm•cm) while the highest resistivity was obtained when SDS (0.5CMC) was used (1.60E+11Ohm•cm). It was shown from this study that the nature and concentration of the surfactant affect the electrical resistivity of the NR/EG nanocomposites.

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References

Bo Z., Yang Y., Chen J., Yu K., Yan J., Cen K. (2013). Plasma-enhanced chemical vapor deposition synthesis of vertically oriented graphene nanosheets. Nanoscale, 5, 5180-5204.

Novoselov KS., Geim AK., Morozov SV., Jiang D., Zhang Y., Dubonos SV., Grigorieva IV., Firsov AA. (2004). Electric field effect in atomically thin carbon films. Science, 306, 666-669.

Puangbuppha B., Limsuwan P., Asanithi P. Non-chemically functionalized graphene exfoliated from graphite in water using ultrasonic treatment. (2012). Procedia Engineering, 32, 1094-1099.

Stankovich S., Dikin DA., Dommett GHB., Kohlhaas KM., Zimney EJ., Stach EA.,Piner RD., Nguyen ST., Ruoff RS. Graphene-based composite materials. (2006). Nature, 442, 282-286.

Tkalya EE., Ghislandi M., de With G., Koning CE. (2012). The use of surfactants for dispersing carbon nanotubes and graphene to make conductive nanocomposites. Current Opinion in Colloid and Interface Science, 17, 225-232.

Zhu Y., Murali S., Cai W., Li X., Suk JW., Potts JR., Ruoff RS. (2010). Graphene and graphene oxide: Synthesis, properties, and applications. Advanced Materials, 22, 3906-3924.