Superior thermomechanical and electrical conductivity of reduced graphene oxide reinforced polyaniline based nanocomposite

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Abstract

Nowadays, various efforts are going on to improve electrical properties of carbon fiber reinforced polymer (CFRP) composites to mitigate the problem associated with low electrical conductivity of epoxy resin based CFRP lighting striking application. In this study, reduced graphene oxide (RGO) incorporated into conducting polymer polyaniline (PANI), doped with dodecylbenzenesulfonic acid (DBSA) with cross linker divinylbenzene (DVB) thermosetting polymer system. RGO was incorporated in different weight (0 to 0.5 wt.%) PANI based system to get PANI-DBSA/RGO-DVB nanocomposites. RGO incorporated PANI-DBSA/DVB nanocomposite was developed by compression moulding method. RGO was characterized by FTIR, Raman spectroscopy and XRD which confirmed the presence of some oxygen-based functional groups on surface and edges of RGO. It is observed that PANI-DSBA/DVB composite with 0.3 wt% RGO content shows significant improvement in flexural strength and modulus by 153% and 32% while electrical conductivity improved by 400%. Also, observed the improved thermal properties and stability of 0.3 wt% RGO incorporated PANI based nanocomposite. The significant increase in electrical conductivity is due to the improvement of electrical transport pathway and molecular level interaction between RGO and PANI-DBSA/DVB system. The storage modulus, glass transition temperature (Tg) and thermal stability are maximum in case of 0.3 wt% RGO incorporated PANI-DBSA/DVB nanocomposite. Interfacial bonding between RGO and PANI-DBSA/DVB polymer system is analyzed by FTIR and Raman spectroscopy and it confirmed the formation of H-bonding and π-π interaction between reinforcing constituents which agrees with HRTEM studies of PANI/RGO interface. Thus, RGO is constructive for improving the thermo-mechanical and electrical properties of PANI based system which can be used for development of conducting CFRP for different applications.

Image

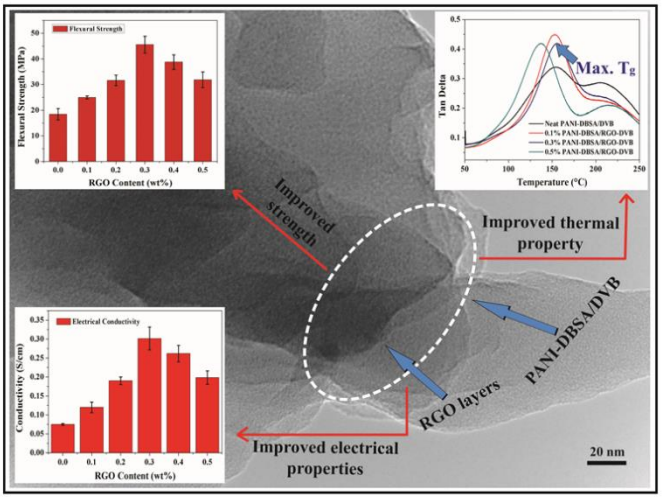


Figure 1: The effect of improved interfacial bonding in RGO reinforced PANI-DBSA/RGO-DVB nanocomposite on mechanical, electrical and thermal properties.

Recent Publications

1. Pathak et al. (2016) Improved mechanical properties of carbon fiber/graphene oxide-epoxy hybrid composites, Composites Science and Technology 135, 28-38
2. Hirano et al. (2016) Lightning damage suppression in a carbon fiber-reinforced polymer with a polyaniline based conductive thermoset matrix, Composites Science and Technology 127, 1-7.
3. Kumar et al. (2016) Synthesis and characterization of PANI-DBSA/DVB composite using roll-milled PANI-DBSA complex, Polymer 86, 129-137.
4. Kumar et al. (2015) Mechanical and electrical properties of PANI based conductive thermosetting composites, Journal of Reinforced Plastics and Composites 34(16)1298-1305.
5. Kumar et al. (2017) Irreversible tunability of through-thickness electrical conductivity of polyaniline-based CFRP by de-doping, Composites Science and Technology 152, 20-26.

Photograph



Biography

Mr. Abhishek has his expertise in carbon nanomaterials synthesis and its application in CFRP composites for structural applications. His new style of finding the importance of nanomaterials in CFRP composite and its interfacial interaction study has opened new pathways in aerospace industries. He has developed the new way of understanding the interface chemical bonding of CFRP composite and designing of new carbon nanomaterials for improved binding with carbon fiber and polymer. He has done master in chemistry with organic chemistry specialization from University of Delhi, India in 2013. Now, he is a Ph.D. research scholar in CSIR-National Physical Laboratory, New Delhi, India. He was a university football team member during his bachelor study in University of Delhi and also played for many Delhi football clubs.

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