

Title

FUNCTIONALIZATION OF GRAPHITE OXIDE SHEETS AS A TOOL FOR THE PREPARATION OF ELECTRICAL CONDUCTIVE POLYMER/GRAPHITE OXIDE COMPOSITES

Abstract text

Recently, graphene based materials have attracted much interest due to their remarkable properties and promising applications. From an industrial application point of view, the most promising method for large scale production of graphene is based on the oxidation of graphite leading to graphite oxide (GO), which can subsequently be functionalized, followed by its reduction to restore electrical conductivity. Herein, the preparation of polyethylene/graphite oxide composites exhibiting rheological and electrical percolation thresholds was accomplished by radical addition reactions onto the unsaturated system of graphite oxide sheets through the use of pentadecane and polyethylene in presence of peroxides as well as azide-terminated polyethylenes. This chemical functionalization influences solubility behaviour of the formed pentadecane and polyethylene grafted GO sheets in various solvents. Moreover, the compounding of the composites pentadecane grafted GO/PE was performed at a processing temperature of 140°C with 25, 20, 15, 10, 8 and 5 wt% loadings. Rheological and electrical percolation thresholds were found between 10 and 15 wt% for polyethylene / pentadecane functionalized graphene oxide composites while the composite graphite/PE at the same loading percentage did not reach any percolation threshold. Polyethylene and azide-terminated polyethylenes were also converted to macroradical and nitrene, respectively by performing grafting reactions at 190 °C in 1,2,4 trichlorobenzene as solvent. Dispersion of PE coated graphite oxide in a DMF/heptane mixture was utilised to follow the introduction of polyethylene onto the GO sheet surface while the thermogravimetric analysis indicated the extent of this grafting. The grafting ratio was found to be in the 1.5 wt% range and despite this low grafting content, the amount of grafted PE was high enough to dramatically improve the affinity of GO with the heptane phase in DMF/Heptane (50/50 v/v) mixture. Polyethylene functionalised GO was imaged by scanning electronic microscopy showing a significant difference in morphology between the two grafting paths. It was found that a higher level of grafting was obtained using a radical grafting reaction in presence of benzoyl peroxide rather than the thermal cleavage of PE-N3 onto GO while a similar grafting content was obtained with the thermal cleavage of PE-N3 onto GO grafted trimethoxy(7-octen-1-yl)silane.

In addition, polydimethylsiloxane (PDMS) was grafted onto graphite oxide sheets through two routes. The grafting reactions were performed in toluene as solvent via an hydrosilylation reaction and a hydrolysis condensation reaction in presence of SiH-terminated PDMS and ethoxysilane-terminated PDMS, respectively. Dispersion of PDMS coated graphite oxide in a PDMS oil was utilised to follow the introduction of PDMS onto the GO sheet surface while X-ray photoelectron spectroscopy and thermogravimetric analysis indicated the extent of this grafting. The grafting densities were found to vary from 0.7 10⁻³ mmol.g⁻¹ to 12.7 10⁻³ mmol.g⁻¹ depending on the PDMS molar mass. It was found that a higher level of grafting was obtained using an hydrosilylation reaction with low molar mass SiH-terminated PDMS rather than a sol-gel process with the use of ethoxysilane-terminated PDMS.

Keywords

GRAPHENE, FUNCTIONALIZATION, POLYETHYLENE, POLYDIMETHYLSILOXANE, RADICAL GRAFTING

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