Experimental report

13/02/2017

Proposal: 9-12-372 **Council:** 10/2014

Title: Distortions in polymer conformation at the filler interface: polymer-graphene oxide nanocomposites

Research area: Materials

This proposal is a new proposal

Main proposer: Mike WEIR

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Samples: PMMA/GO nanocomposite

Instrument	Requested days	Allocated days	From	To
D11	3	2	17/07/2015	19/07/2015

Abstract:

Graphene and related materials have extraordinary physical properties. By incorporating these two-dimensional materials into polymer composites, such properties may be married with the processability and properties of the host polymers. We currently concentrate on graphene oxide (GO)/poly(methyl methacrylate) (PMMA) nanocomposites due to the chemical compatability between the components. The interaction between polymer and filler in the interfacial region is crucial in the performance of the nanocomposite. This experiment aims to investigate the conformations of the polymer chains near to the filler interface. Our recent SANS measurements have shown that the Rg of PMMA in PMMA/GO exhibits a minimum in Rg near to the percolation threshold. This experiment proposes to the study the Rg of PMMA as a function of molecular weight and GO concentration, in order to understand the role of molecular weight and to test simple models of interfacial interactions in nanocomposites.

Distortions in polymer conformation at the filler interface: polymer-graphene oxide nanocomposites

9-12-372

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From 17/07/2015 to 19/07/2015

Experimental report

We report a successful SANS experiment on D11 lasting for 48 hours. The experiment was simple transmission mode SANS, aiming to measure the shape and size of polymer chains in polymer-graphene oxide nanocomposites. This experiment exploited the use of isotopic substitution in order to study blends of hydrogenated and deuterated poly(methyl methacrylate) (PMMA). Polymer nanocomposites of the h/d PMMA blend were formed with various concentrations of graphene oxide (GO) via a solvent processing method. The GO concentrations varied from 0-10 per cent by weight. Various molecular weights of PMMA were used with the hydrogenous and deuterated components matching closely.

Due to the stable nature of the samples at room temperature a simple sample changer and program was used to scan through samples and camera lengths with data collection progressing without any major issues to report. There was no loss of time due to beam outage, sample environment or mechanical issues.

After reduction the data are excellent in terms of statistics, and will form the backbone of a planned publication. A dataset from the experiments is included for illustration in Figure 1. The full conclusion of the data requires further analysis of data from complementary techniques, but the data appear to show significant new effects and should advance our understanding of interfacial effects in polymer nanocomposites.

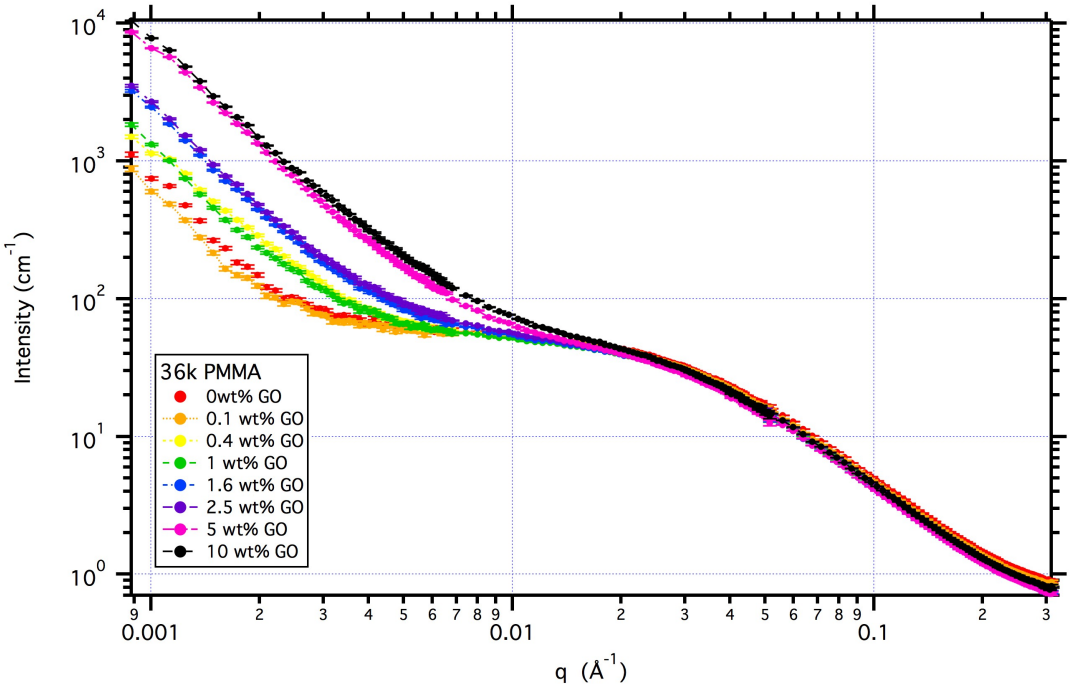

Figure 1. SANS data collected from the D11 instrument during the reported experiment, on PMMA-GO nanocomposites.

We would like to take this opportunity to thank the ILL for a very good experimental experience and great support from the beamline and technical teams.