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Interfacial confinement in polymer-graphene oxide nanocomposites

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Graphene and related two-dimensional materials are excellent candidates as filler materials in nanocomposites due to their extraordinary physical properties and high aspect ratio. We are currently studying graphene oxide (GO), a highly functionalized form of graphene, due to its relative ease of dispersion within polymer matrices.

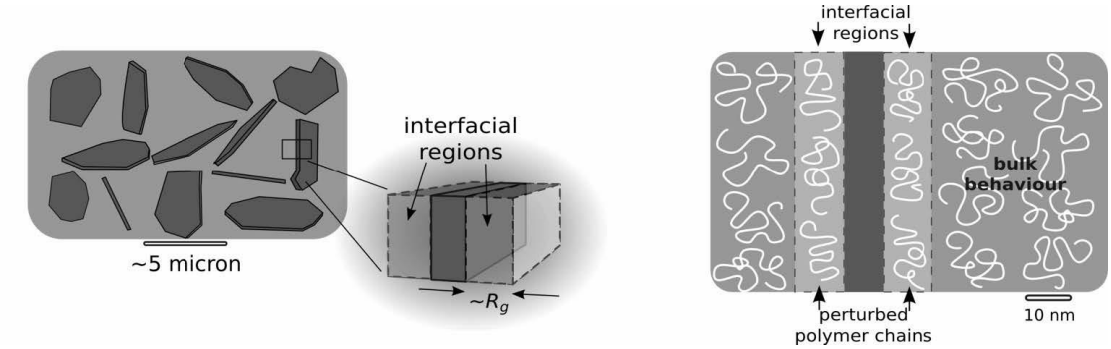

Fig.1 (a) A schematic diagram of a polymer-graphene oxide nanocomposite, highlighting the interfacial regions extending approximately R_g from the interface. (b) Within the interfacial regions the polymer chains are distorted; due to the confinement R_g is reduced in the direction normal to the interface

The polymer physics in the interfacial region (see Fig. 1 (a)) between the nanoparticle and the bulk polymer is of great importance in the understanding of nanocomposite performance [1]. Furthermore, the large specific surface area of well-dispersed 2D nanomaterials means the volume affected by the interface is significant even at nanoparticle loadings of ~1 % by volume. This makes them an excellent system for using bulk techniques to study interfacial effects. Small-angle neutron scattering measurements, highlighting the conformation of individual polymer chains, show a decrease in polymer radius of gyration R_g (see Fig. 1 (b)) with increasing GO concentration in PMMA/GO nanocomposites. The decrease is consistent with models of solid interfaces within a polymer melt [2,3]. Rheological measurements show that this chain distortion reduces the number of entanglements between neighbouring chains, which confirms that the interfacial chains overlap less with their neighbours than those in the bulk.

This work is a direct measurement of the effect of a high aspect ratio nanoparticle upon the polymer matrix and progresses our understanding interfacial interactions within nanocomposites.

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[3] Sussman, D. M., et al. *Macromolecules* 47, 6462–6472 (2014)