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RHEOLOGY OF PDMS/GRAPHENE SUSPENSIONS

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Recently discovered graphene has become of great interest to researchers in the electronic and nanocomposite fields thanks to its exceptional properties such as high conductivity, good mechanical properties and its important aspect ratio (diameter/thickness > 100). Over the course of our study on graphene as nano fillers in nanocomposites, the rheological behavior of PDMS/graphitic filler suspensions has been studied. The graphitic fillers correspond to graphite powder, graphite oxide (GO) and functionalized graphite oxide with 3-(acryloxypropyl) trimethoxy silane (GO-APTMS). The chosen PDMS has a low viscosity of 1 Pa.s (Rouse regime). The PDMS/graphite and PDMS/GO-APTMS suspensions present a Newtonian behavior similar to the PDMS matrix whereas, the PDMS/GO suspensions have a shear thinning behavior once the rheological percolation threshold reached (~2.5 wt%). In the case of the PDMS/graphite suspensions the graphite particles have a low Van der Waals interaction and a diffusion given their non nanometric dimensions. The rheological behavior of the PDMS/GO-APTMS is linked to the favorable filler-matrix interaction which leads to a stable suspension preventing any network formation by partial aggregation of the nano sheets. For the PDMS/GO suspensions there is a high interaction between GO nano-sheets leading to their aggregation which allows rheological percolation. In order to obtain a low percolation threshold, a certain degree of primary aggregation is needed. Fillers which are too well dispersed and stabilized by surface grafting do not lead to a conductive system. Thus a system presenting a primary aggregation phenomenon seems more suitable for achieving low percolation thresholds.