Synthesis and Relaxation Study of Poly(dimethylsiloxane) (PDMS)/Polyhedral oligomeric silsesquioxane (POSS) Composites

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Polydimethylsiloxane (PDMS) melts containing nanoparticles in either chemically or physically bonded composites have been widely studied because addition of nanoparticles provides an improvement of both thermal and mechanical properties of these materials [1]. A wide variety of nanoparticles has been used including polyhedral oligomeric silsesquioxane (POSS) and trimethylsilyl-treated polysilicates. Incorporation of POSS into a linear polymer can improve the properties of the material. The improvements include increased glass transition, degradation and use temperatures, increased oxidation resistance, surface hardening and improved oxygen permeability and reduced flammability [2]. Most POSS/PDMS nanocomposites have been synthesised in the form of cross-linked and copolymer materials rather than as POSS/PDMS triblock polymers. The primary aim of this work is to produce the simplest model of the PDMS/POSS nanocomposite, see Figure 1(a). We have synthesised three samples of the dumbbell shape PDMS/POSS composite via a hydrosilylation reaction. The molecular weights of the PDMS middle chain range from 580 to 24,000 g.mol$^{-1}$. The reaction products were characterised by $^1$H NMR, FT-IR spectrometry and gel permeation chromatography (GPC). The impact of POSS on the molecular mobility of the PDMS middle chain was then studied by using the $^1$H spin-spin ($T_2$) relaxation NMR technique. The relaxation decays are shown in Figure 1(b). It is apparent that covalent incorporation of POSS leads to a change in relaxation showing that the effective PDMS middle chain mobility is restricted when it is end-capped with POSS.

![Diagram](a)

**Figure 1** (a) the schematic representation of the POSS/PDMS triblock polymer and (b) NMR relaxation decays of POSS/PDMS triblock polymers in comparison with PDMS melts.