Preparation and Properties of Polyimide-Clay-Siloxane Hybrids

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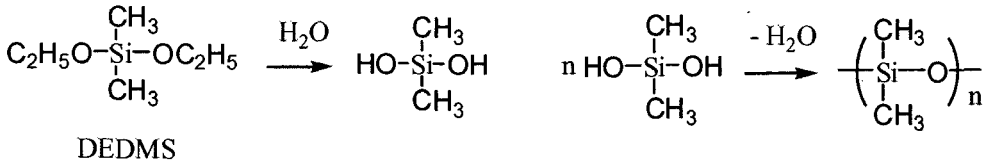
Nanocomposites from polyimide (PI) and organically modified montmorillonite (OMMT) increase thermal stability, tensile modulus, tensile strength and glass transition temperature (T_g), but araise brittleness which effect on the utility of PI film [1-5]. To overcome this, a series of PI-clay-siloxane hybrid films with silica content up to 50% were successfully prepared by the sol-gel reaction of diethoxydimethylsilane (DEDMS) (Scheme 1) in the presence of poly(amide acid). Poly(amide acid) were prepared from pyromellitic dianhydride (PMDA) and 4,4'-oxydianiline (ODA). OMMT was prepared by surface treatment of montmorillonite (MMT) with n-hexadecyltrimethylammonium bromide.



Scheme 1. Preparation of polydimethylsiloxane

Completion of imidization within 300°C was observed through Differential scanning calorimetry. X-ray diffraction indicated that the OMMT layers were exfoliated and dispersed into the poly(amide acid) and polyimide films. The films were yellow and transparent when the siloxane content was less than 5%.

PI(PMDA/ODA) with 2% OMMT and 5% siloxane increased the tensile modulus, tensile strength and elongation at break than the pristine PI (Table 1). Two glass transition temperatures of the hybrid composites were found in Dynamic mechanical analysis through Visco-elastometer. Thermogravimetric analysis showed that the hybrids have higher decomposition temperature which reflects better thermal stability of the composites.

Table 1. Tensile properties of various hybrid films

Clay (%)	Siloxane (%)	Modulus (GPa)	Strength (MPa)	Elongation (%)
0	0	2.2	58.2	36.4
2	0	4.0	69.6	11.4
2	5	4.0	92.7	77.2

References

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