PRESSURE SENSITIVE ADHESIVE COMPOSITES USING SURFACE MODIFIED GRAPHENE OXIDE

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ABSTRACT

Pressure sensitive adhesives (PSAs) composites are viscoelastic materials with very low modulus of elasticity as of elastomers that exhibit good adhesion to solid surfaces under light contact pressure in a short contact time. PSAs are applied for many products including adhesive tapes, glues, labels, medical pads, and automobiles. Besides, up to now, PSAs is more and more used in the electronic industries. The use of acrylic PSA polymer is raising because it has good transparency without yellowing properties and good adhering activity. However, the acrylic PSAs need the balanced properties of tackiness, peel strength and shear strength to adapt to the requirement of each specific application.

The polymeric materials have thermal insulation property and the thermal conductivity of general PSAs is near 0.17 W/m K, which is far below the requirements of the effective heat dissipation. The PSAs composites with thermal conductive fillers can increase the thermal conductivity. Graphene oxide (GO) has attracted interest due to its unique properties such as large surface area, high mobility, and high thermal conductivity for a wide range of applications including electronic devices optical applications, and super capacitors. Graphene oxide with functional groups can be dispersed and exfoliated in the polymer matrix due to its good interaction with polymer. However, the high surface area and van der Waals' interaction of GO leads to the severe aggregations and it limited the application of GO.

Pressure sensitive adhesive composites containing isophorone diisocyanate and hydroxyl-ethylmethacrylate functionalized graphene oxide (IPDI-HEMA-fGO) were prepared. The effects of the surface modified graphene oxide (GO) on the thermal conductivity, peel strength and initial tack of the composites were studied. The hydrophobicity of the GO resulting from the IPDI-HEMA surface modification enhanced the compatibility between GO sheets with the polymer matrix. The thermal conductivity of the IPDI-HEMA-f-G/composites was near 3 times greater than the thermal conductivities of the bare polymer matrix. The peel strength and probe tack of the IPDI-HEMA-fGO/PSAs were investigated as a function of surface modified GO loadings.

The peel strength of PSAs composites as a function of total weight fraction of fillers is shown in Figure 1. It is noticeable that the peel strength of PSA composites decreased with increasing the weight fraction of fillers. It can be suggested that the higher amount of filler might decrease the initial adhesion or tack of PSAs composites. It is clearly seen that there is a decrease of the adhesive properties with increasing the amount of GO fillers. With adding the GO fillers in PSAs composites, the peel strength decreased compared to the bare matrix. A sharp decrease in peel strength is attributed to the poor wetting of IPDI-HEMA-fGO/PSAs composites on the stainless steel substrate.

The probe tackiness of PSAs composites as a function of GO is also shown in Figure 1. With a small amount of GO loadings in the PSA matrix, the tackiness of PSAs composites slightly increased. We assume that the small amount of GO fillers in the PSAs matrix might block UV irradiation and it caused the less UV crosslinking. The poor UV-crosslinking may increase the tackiness of the PSAs composites.

This study reveals the effects of hydrophobic surface modification of GO fillers on the adhesive properties and thermal conductivity of the PSAs composites.

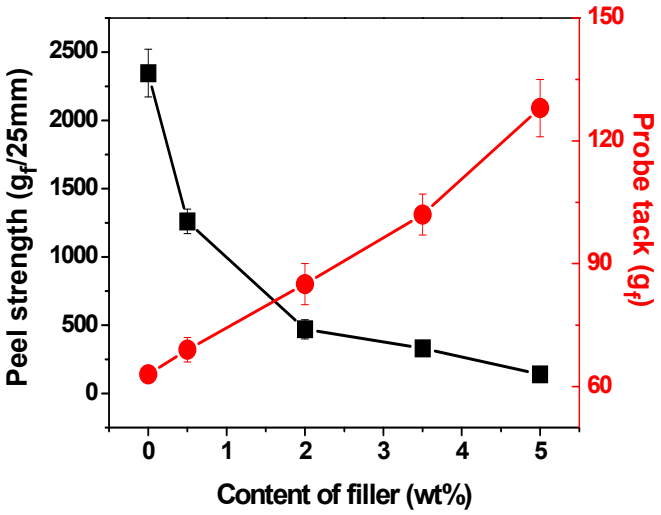

Figure 1: Peel strength and probe tack of PSA composites as a fraction of functionalized GO fillers.

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