

Nanocomposites and nanomaterials

Nanocomposites Based on Thermosetting Polyurethane and Multi-Walled Carbonnanotubes with Surface Functionalization

L.V. Karabanova¹, R. L. Whitby², A.W. Lloyd², S.V. Mikhalovsky²

¹ Institute of Macromolecular Chemistry of NAS of Ukraine, Kharkov Road, 48, Kiev-02160, Ukraine. E-mail: lyudmyla_karaban@ukr.net

² University of Brighton, Moulsecoomb Brighton, United Kingdom

The thermosetting Polyurethane-MWCNT nanocomposites with 0.01 - 0.25 wt. % of nanofiller were prepared and studied using chemical analysis, SEM, TEM, DMA, stress-strain testing.

Via acid oxidation and reduction chemical procedures hydroxyl, carboxyl, phenol functional groups to be used as cross-linking sites to the matrix were generated on the MWCNT surface[1]. Good nanotubes dispersion in the PU matrix were observed by SEM and TEM for the nanocomposites with ultralow contents of functionalized MWCNTs (0.01 and 0.1%) whereas both individually separated nanotubes and their small agglomerates were presented in the matrix at 0.25 % nanotubes.

The strong dependence of nanocomposite's glass transition and dynamic mechanical performance on variations in the nanotube surface chemistry was demonstrated: the large impact of MWCNTs was observed only at direct covalent bonding between PU matrix and nanotube lattice. The pronounced dynamic heterogeneity within the PU glass transition was registered by DMA analysis.

The mechanical properties testing indicated that small amount MWCNTs (0.01%) could significantly improve the mechanical performance of the matrix. The tensile strength was increased from 2.0 MPa to 4.0 Mpa (Fig.1).The best results were obtained for nanocomposites containing MWCNTs which covalently bounded to the matrix: the Young's Modulus increased by 2–4 times depending on concentration of nanotubes.

Fig. 1 Stress-Strain curves for the native PU (1) and for the nanocomposites with 0.01 (2), 0.10 (3) and 0.25 (4) wt% of MWCNT-ox

1. Karabanova L., Whitby R., et al. Microstructure changes of polyurethane by inclusion of chemically modified carbon nanotubes at low filler contents// Comp. Sci. and Technol.-2012.- 72,-P. 865-872.