Polymer-Nanodiamond Composites: Preparation, and Characterization

Karbushev V.V.*, Konstantinov I.I.*, Kulichikhin V.G.*, Khodzhaeva V.L., Popov V.A.[+]

**Topchiev Institute of Petrochemical Synthesis RAS, Leninskii pr. 29, 119991 Moscow, Russia*

[+]Moscow Institute of Steel and Alloys, Leninskii pr. 4, 119049 Moscow, Russia

Nanodiamonds (ND) are one of the most important materials from both a fundamental and practical standpoint due to their unique combination of properties. To transfer efficiently the superior properties of ND to polymer matrix in lightweight and strong composites for use in many fields we need to achieve the fine dispersion degree and desirable interfacial adhesion between particles and polymer matrix. The wide spread melt mixing is not capable to solve a problem of nanoparticles desaggregation. It was shown, that for achievement of good dispersion of ND particles in the case of mechanical melt processing is necessary to provide conditions of elastic turbulence ("spurt" regime). For powdery polymers, the new efficient "colloidal – deposition" method, when immobilization of the filler on a surface of polymer occurs in inert liquid medium under sonication, have been developed. Above mentioned methods have been worked out for distribution of ND in amorphous polymer matrices: polysulfone (PSF) and styrene-acrylonitrile copolymer (SAN). For estimation of nanodiamond distribution in the polymer matrix the methods of optical and scanning electron microscopy were used. In order to reduce ND particles tendency to aggregation some attempts have been offered to change their functional cover. Chemical and physical-chemical modifications of functional groups of ND were carried out by trifluoromethane sulfonic acid and hexafluoroisopropanol respectively. FTIR data of the modificated ND particles indicates on essential decrease of band intensity corresponding to carboxylic groups (1715, 1590, 950 cm^{-1}). By means of an original technique the sliding friction coefficient and wear resistance of composites relatively nichrome has been measured. The wear resistance of modified by ND polymer increases essentially in comparison with neat polymer. The composites have been tested for Izod impact strength. Already 0.5 wt.% of ND results in increase of impact strength almost 2 times. Standard measurements of Brinell Hardness have shown its essential increase at introduction of ND particles. Thus, modification of polymers by ND leads to improvement of their mechanical and tribological characteristics.

This work is supported by the ISTC foundation (project № 3238), ROSNAYKA (contract № 02.523.11.3003) and RFBR (grants № 07-03-00998 and 06-03-89403).