Nanocarbons as physical modifier of polymers – dispersity or structure

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Incorporating of nanocarbons in polymer matrix is nowadays considering as the most effective way for new generation polymer materials development. But experimental findings are often differ from ones predict by theory. These facts may be the consequence of more complex mechanism of nanoparticles effect on supramolecular structure of polymer matrix and, as result, on properties of polymer nanocomposite obtained. In this study we investigated, as an example, polymethylmethacrylate (PMMA) and it's composite with fullerenes, MWCNT and detonation nanodiamonds (DND).

Our findings demonstrate that filling of the origin polymer with MWCNT practically don't influence on PMMA thermal destruction parameters. At the same time, nanocomposites based on C60 and DND demonstrate significant reduction (more then 200°C) of the temperature of thermal destruction process start. It was also shown ambiguous results of ultrasonic (US) exposure on nanocomposite solution.

Current opinion is that US result only in uniform nanoparticles distribution all over polymer matrix. But our findings show that the different time of US exposure on solution of DND-based nanocomposite result in clear-cut distinction in thermal parameters of destruction process. Thus, if the shot period of US exposure (1 min) result in pronounced peak of thermodistraction of nanocomposite (at 520 K), then the US exposure over a long period of time (40 min) result in more intensive but widened peak (over the range 450 to 650 K). Such result we connect with influence of US exposure on polydispersity of DND aggregates.

The findings, in our opinion, give evidence that the determinant of nanoparticles influence on polymers nanocomposite properties is not dispersity of particles, but their fine internal structure (static for MWCNT and fractal for C_{60} and DND). Also we suggest that in our experiments the US exposure stimulate interaction of macromolecules with functional groups of DND surface.