

# Nanocomposites and nanomaterials

## Structural features of prepregs formation based on polyamide fibers and thermosetting bonding matrix modified by carbon nanoparticles

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Major functional properties of prepregs provided a "matrix fiber" adhesive strength in the compound's unit cell and the contribution of the fibers strength properties to the strength of the polymer composite material.

In this paper, it was studied the effect of carbon nanostructures: carbon nanotubes (CNT), the detonation nanodiamonds (DND), mechanically activated detonation nanodiamonds (MDND) in the concentration range for indicators characterizing adhesive interaction in the system of bonding matrix bakelite phospholyol-hydroxypropyl composition (BPHC) and polyamide paper Nomex<sup>®</sup>.

It was revealed MDND provides the steady decline in the contact angle, and the effect of CNT is extreme. Observed wetting improvement in the case of CNT and MDND is caused change of oligomeric chains conformation and the formation more oriented denser layer of oligomeric chains at the interface. According to molecular spectroscopy research it was observed optical density change due to the orientation phenomena associated with  $\pi$ - $\pi$  aromatic rings interactions, owing to the occurrence of the intramolecular H-bond.

Carbon objects MDND and CNT are surface active for binding matrix due to better absorption. DND is adsorbed onto the surface of the matrix negatively and it is surface inactive towards matrix. In the paper, the characteristics of the adhesive interactions are obtained: the work of adhesion, the work of cohesion, the work of spreading, the adhesion tension, the relative work of adhesion.

Comprehensive physical and mechanical tests of produced prepregs on the basis of polyamide fibers Nomex<sup>®</sup> and Kevlar<sup>®</sup> are performed. Prepregs are characterized by an increase of compressive strength. In general, increasing the strength of the prepregs in the region of low nanoparticles concentration on the average is from 30 to 50%. There is a correlation between the trends of the work of adhesion growth and increased strength indicators with the increment of nanoparticles concentration.