

Nanocomposites and nanomaterials

Monothreads of nanofilled compatibilized polymer blends – structure and properties

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Matrix-fibrillar morphology in thermodynamically incompatible polymer blends by proper conditions is formed. The mechanical properties of composite filaments can be changed by regulation of the ratio of length and diameter fibrils.

The main aim of this thesis is to study the impact of nanoadditives and compatibilizers on micro-structure of polypropylene/co-polyamide (PP/CPA) extrudate blends and on the mechanical characteristics of monofilaments that were formed from them.

The object of the research is monofilament composite formed from blends of PP/CPA composition 20/80 by weight. % and with addition of carbon nanotubes (CNT) and compatibilizer which consist of PP graft with maleic anhydride (PPgMA). The content of CNT and PPgMA that were used in blends was 2.0 and 3.0 wt. %. accordingly. Monofilaments were formed on a laboratory bench by jet drawing (1000%) with temperature 150°C and drafting ratio from 4.5 to 5.0.

The investigations show that the mechanical properties of the monofilaments binary blend higher than the properties of initial CPA. Injection of nanofiller or compatibilizer helps for further increase of the strength and initial modulus of filaments. The strength and elastic modulus of filament ternary compositions grow ~ 1.3 times compared to the initial blend. Threads with quaternary system are characterized by the highest mechanical properties, tensile strength and initial modulus, they are 390 and 5110 MPa, accordingly (comparing with 260 and 3870 MPa for bicomponent blend). This occurs due to the formation of self-reinforcement for PP microfibers in the CPA matrix. Mechanical properties are related to process of structure formation for dispersed phase component in the matrix. Conducted microscopic studies confirmed the process of structure formation was improved: average diameter of microfibers decreasing from 2.6 microns to 1.5 microns, their weight content, also, increasing and the quantity of films decreasing rapidly.

Thus, the maximum effect for improvement of the properties for filament with compatibilized nanofilled compositions are the result of synergistic action of the two modifiers: self-reinforcement through the formation of PP microfibers in CPA matrix, improvement of matrix-fibrillar morphology, growth of adhesion on the interphase division and filling of carbon nanotubes.