ABSTRACT

This thesis presents the study of nanocomposites based on immiscible polymer blend of polycarbonate and acrylonitrile-butadiene-styrene (PC/ABS) filled with multi-walled carbon nanotubes (MWCNT). The aim is to achieve an improvement of mechanical properties and electrical conductivity of the nanocomposites.

In an initial stage, a twin-screw extruder was used to obtain nanocomposites by melt compounding. Three methods of carbon nanotubes addition were studied: direct addition, dilution from a masterbatch and feeding of MWCNT suspension in ethanol. For each method, the influence of nanofiller content and processing parameters on morphology and final properties of the nanocomposite was analyzed. Furthermore, the influence of two types of carbon nanotubes modifications was studied: covalent modification by surface-oxidation (MWCNT-COOH) and non-covalent modification by an addition of surfactant promoting the nanofiller-matrix interactions.

A good dispersion of the MWCNT was obtained for masterbatch dilution and suspension feeding. Both methods showed preferential localization of carbon nanotubes in polycarbonate phase (PC).
Samples processed by masterbatch dilution showed the 30 % increase of rigidity and a decrease of ductility of PC/ABS for 0.5 wt. % MWCNT. Electrical conductivity was influenced by processing temperature and carbon nanotubes type. The percolation threshold value was 2.0 wt. % for pristine MWCNT and 1.5 wt. % for modified MWCNT-COOH.

Better balance of mechanical properties and electrical conductivity was achieved in the samples obtained by the masterbatch route. These properties were studied in a subsequent phase, when the extruded nanocomposite was injection molded in order to obtain a defined geometry.

Injected samples showed higher homogeneity and thus, higher electrical conductivity when low injection speeds and intermediate melt temperatures were applied. This effect is related to the high orientation and concentration of carbon nanotubes, as well as to occurrence of a skin effect. However, the maximum electrical conductivity achieved after the injection process was reduced by orders of magnitude over the obtained in the compounding stage.

Finally, a mathematical model of carbon nanotubes orientation in injection molded samples was calculated. The results showed a good agreement with the experimental values. A high orientation of carbon nanotubes, exceeding 75 %, in the direction of the flow at higher distances from the injection gate was observed. A loss of the orientation in the injection gate area due to flow disturbances was observed.