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Influence of concentration and electrical field in the morphological properties of polyamide 6, 6 / MWNT nanofibers

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Abstract – Aligned and non-aligned nanofibers of nanocomposites of polyamide 6,6/multiwall carbon nanotubes were successfully electrospun using two different speeds at the rotating collector : 70 and 2000 rpm. Initially, the multiwall carbon nanotubes (with and without carboxylic functionalization) were dispersed in formic acid with ultrasound and later magnetic stirred. The polyamide 66 pellets were dissolved in the same solvent at two concentrations: 15 and 18 wt%/v . Electrical fields were set at 3, 4, 5 and 6kV/cm. Scanning and transmission electron microscopy showed nanofibers with diameters ranging between 80 and 250 nanometers.

Nanofibers of nanocomposites of polyamide 6,6/multiwalled carbon nanotubes (with and without functional carboxylation) were successfully produced by electrospinning at two main concentrations (15 and 18 weight %/v) and electrical field of 3, 4, 5 and 6kV/cm. The influence of the functionalization, polymer concentration and electrical field on the morphology was analyzed by scanning and transmission electron microscopy.

The result showed that the increase of the polyamide 66 concentration (15 to 18 weight %) in the solutions increased the nanofibers average diameter. On the other hand, the morphology of nanofibers produced by solutions whit higher concentrations was less homogeneous (fig. 1). This fact was associated to the difficulty in the jet formation when the solution concentration or the corresponding viscosity was too high [1].

The increase of the electrical field showed an increase in heterogeneity of the nanofiber morphology; the best electrical field (best morphology) was between 3 and 4 kV/cm. The alteration of the capillary tip-collector distance changed the nanofiber morphology (fig. 2). This could be explained by the changing of flow rate which occurred with the increase in the electrical field. When the flow rate exceeded a critical value, the delivery rate of the solution jet to the capillary tip exceeded the rate at which the solution was removed from the tip by the electrical forces. This shift in the mass-balance resulted in sustained but unstable jet and non-homogeneous nanofibers were formed [2].

Furthermore, carboxilated MWNT tend to form more homogeneous nanofibers than the normal MWNT, probably due to the interactions between the carboxylic groups of the functionalized MWNT and the amine groups of the nylon 66, resulting in a better interface [3].

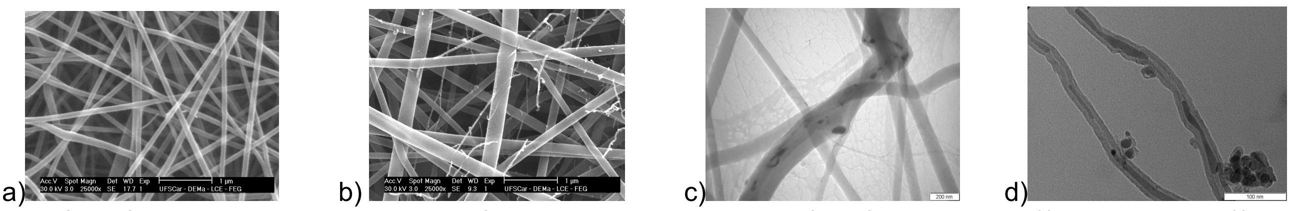

Fig.1. SEM of polyamide 6,6/MWNT (normal) nanofibers prepared using an electrical field of 5 kV/cm: a) 15wt% solution and b) 18% solution; c)TEM of polyamide 66/MWNT nanocomposite; d) TEM of multiwalled carbon nanotubes.

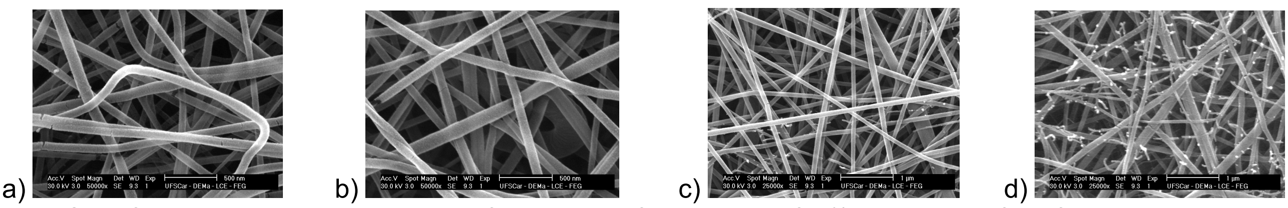

Fig. 2: SEM of polyamide 6,6/MWNT (normal) nanofibers prepared from a solution of 15%wt. a) Electrical field of 3 kV/cm; b) Electrical field of 4kV/cm; c) Electrical field of 5 kV/cm; d) Electrical field of 6 kV/cm.

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