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Study of Electrical and Optical Properties of PMMA filled with Indium Tin Oxide Nanobelts

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Abstract – Nanocomposites of PMMA filled with ITO nanobelts were produced using a simple route in order to obtain transparent and conductive materials. The results showed that percolation for this system occurs when about 5% of filler is introduced in the PMMA matrix, and the transparence in the visible range is not significantly altered. SEM results confirm the percolation at this concentration, and support the electrical results.

Nanocomposites are materials that have two or more solid phases, and at least one of them should present one dimension below 100 nm. They are known as multifunctional materials because they have, usually, more than one property increased for some special application. Up to now, a great effort has been done by researches to achieve multifunctional nanocomposites of polymeric matrices filled with metallic, ceramic or inorganic phase, and in this work we studied the influence of conductive ITO (*Indium Tin Oxide*) nanobelts on the electrical and the optical properties of Poly(methyl methacrylate) polymer. The nanobelts were synthesized by carbothermal reduction process, using a co-evaporation method, and have controlled size, shape, and chemical composition. The electrical measurements of nanobelts showed they have a resistance of about 10^2-10^5 Ω. In order to produce nanocomposites films, nanobelts were dispersed in toluene using an ultrasonic cleaner, so the PMMA polymer was added, and the system was kept under agitation up to a clear solution be obtained. The PMMA polymer was filled with 1, 2, 5 and 10 % in weight of nanobelts, and the films were done by tape casting. The results showed that the UV-Vis spectra in the visible range did not change significantly after the addition of nanobelts. The resistance of nanocomposites decreases by increasing the amount of filler, and with 5% in weight of nanobelts the resistance is about 10^5-10^7 Ω, which means that percolation of nanobelts occurs for this concentration. This is an interesting result once for nanocomposites filled with ITO nanoparticles is necessary about 18% in weight to obtain percolation. The composites were also analyzed by scanning electron microscopy (SEM), and the SEM results are in agreement with the electrical one about percolation of nanobelts. These results are promising once indicates that is possible to produce conductive and transparent in the visible range films by the addition of ITO nanobelts in a polymeric matrix using a simple route.

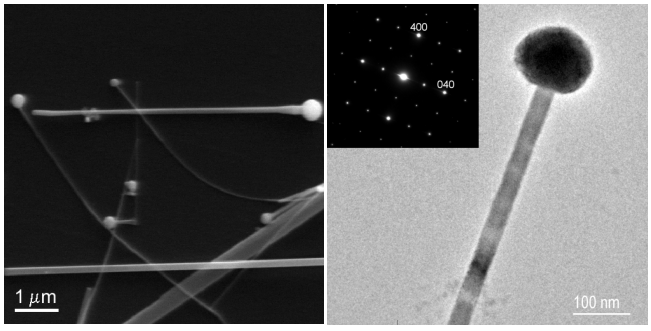

Figure 1: a) SEM image of ITO nanobelts. b) TEM image of a single belt with the respective SAD pattern.

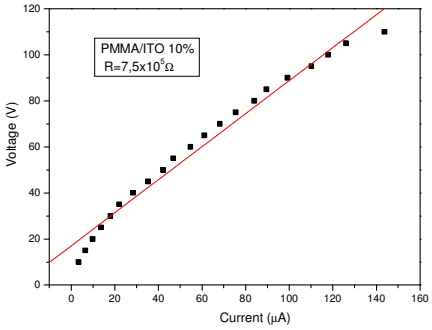

Figure 2: 2 probes electrical measurements of nanocomposite filled with 10% wt of ITO.