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Study of electrical conductivity of polythiophene/montmorillonite nanocomposites

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Abstract – Nanocomposites of polythiophene, poly(3-hexylthiophene) and poly(3-hexadecylthiophene) with natural and organophilic clays were synthetised by the *in situ* polymerization method. The nanocomposites were characterized by X ray diffraction (XRD), transmition electron microscopy (TEM) and conductivity mesurements. The conductivity of the nanocomposites depends on the type of strucutre formed and enhancements of electrical conductivity were observed for the intercalated nanocomposites.

Conducting polymer/clay nanocomposites have been widely studied due to improvements in mechanical [1,2], thermal [3] and electrical [4,5] properties obtained for low quantities of load. These improvements can increase the technological applicability of these materials [6].

Polythiophenes form an interesting class of polymers due to the variety of properties presented by them [7]. The addition of alkylic groups to the thiophene backbone imparts solubility and fusibility to the polymer. On the other hand, these alkylic chains promote distorsion in the main chain of the polymer, thereby decreasing its conductivity. Recent studies on conductive polymers showed an enhancement on conduction in polymers confined between clay lamellas, as this condition prevent distortion of these chain, increasing sequence of π bonds [4,5].

Nanocomposites of polythiophene, poly(3-hexylthiophene) and poly(3-hexadecylthiophene) with 2 natural (Brasgel® and Volclay®) and an organophilic clay (Claytone 40®) were prepared by *in situ* polymerization with ferric chloride ($FeCl_3$) and characterized by X ray diffraction (XRD), transmition electronic microscopy (TEM) and conductivity measurements (four prob method).

Was observed, for all nanocomposites containing natural clays an intercalated strutcture, while exfoliated structures are obtained when the organophilic clay is used. Nanocomposites of polythiophenes present a decrease in conductivity of approximately 3 ordens of magnitude when compared to the polymer. On the other hand, enhancements on electrical conductivity were observed for nanocomposites of poly(3-hexylthiophene) and poly(3-hexadecylthiophene) with natural clays.

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