

In situ synthesis of conducting polymer blends by a novel double interfacial polymerization method

E.S. Medeiros^(1,2), M. M. Ueki⁽²⁾, R.A. Martinez^(1,2), R. Gregório, Jr. ⁽²⁾, L. H. C. Mattoso^{(1)*}

(1) Embrapa Instrumentação Agropecuária, São Carlos-SP, Brazil

e-mail: mattoso@cnpdia.embrapa.br

(2) UFSCar/DEMa, São Carlos, SP, Brazil

Abstract – A nanostructured blend of polyaniline (PAni) and polypyrrole (PPy) doped with camphorsulphonic acid (CSA) was produced *in situ* by the simultaneous polymerization of aniline and pyrrole using a double interfacial system which comprises of three phases of mutually insoluble liquids with different densities, i.e., organic top phase/ aqueous intermediate phase/organic bottom phase. The blend was SEM, UV-Vis and XRD. Characterization evidenced blend formation rather than copolymerization, thus indicating that this method can be successfully applied to produce *in situ* blends of conducting polymers.

Copolymers and composites of conducting polymers can be chemically or electrochemically prepared by (i) electropolymerization of two monomers in two steps; (ii) one step synthesis resulting in a copolymer rather than a polymer blend; (iii) alternate depositions of two conducting polymers using deposition techniques such as self-assembly and spin coating; and (iv) mixing the conducting polymers (powder or solution) prior to deposition [1-4]. However, polymers have to be mixed properly, which in many cases is a difficult, relatively expensive and time-consuming process, since inefficiently mixing can lead to anisotropic properties and low performance blends. This work dealt with the development of a novel method to produce *in situ* conducting polymer blends using a double interfacial polymerization system which comprises of three phases of mutually insoluble liquids with different densities, i.e., organic top phase/ aqueous intermediate phase/organic bottom phase (Fig.1a) and their characterization by SEM, UV-Vis and XRD.

Fig. 1a shows that both pyrrole and aniline monomers migrate toward the aqueous phase to form a blend as the two interfacial polymerizations take place simultaneously whereas polymers mix together. FESEM micrographs (Fig.1b) show that the morphology obtained is a mixture of nanoparticles (polypyrrole) and nanofibers (polyaniline) rather than a blend. Moreover, UV-Vis spectra (Fig. 1c) corroborate these results showing that the spectrum of the composite comprises of characteristic absorptions of the individual polymers. XRD patterns (Fig.1c) show that the simultaneous polymerization not only yields a blend with each polymer individual structure but also gives rise to new phases due to co-crystallization of PAni and PPy molecules during the synthesis. Although SEM micrographs have shown the existence of a morphology which is typical of each polymer rather than a single phase, at the lattice level some polypyrrole and polyaniline chains co-crystallized modifying the overall crystalline structure without any visible morphological changes.

In summary, conducting blends of polyaniline and polypyrrole were produced *in situ* by a simultaneous polymerization of aniline and pyrrole using a double interfacial system and the characterization evidenced blend formation rather than copolymerization, indicating that this novel blending method can be successfully applied to produce *in situ* blends of conducting polymer nanostructures preserving both the individual morphology and properties of each polymer.

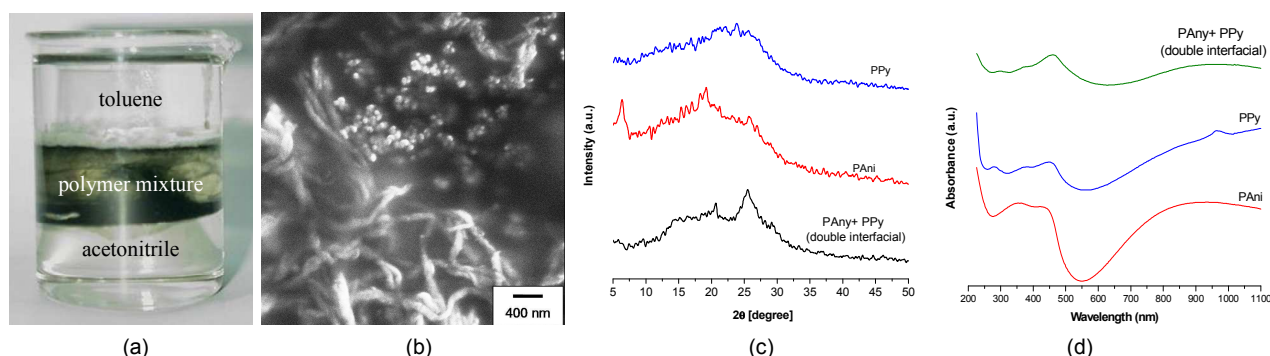


Figure 1: a) snapshot, b) SEM micrograph, c) XRD patterns and d) UV-Vis spectra of the double polymerization system for the synthesis of polyaniline and polypyrrole nanostructures.

References

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