Electrospinned fibers of polypyrrole particles dispersed in polylactic acid

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Abstract

The formation of electrospinned fibers of polypyrrole particles (PPy) synthesized by plasma dispersed in polylactic acid (PLA) with mass ratio PLA/PPy=12 is presented. The particle diameter is in the 0.12-1.2 μ m range with average in 0.3 μ m and that of PPy/PLA fibers was in the 0.22-12.91 μ m range with average in 1.4 μ m. The PLA/PPy average diameter ratio of 4.66 suggests that the particles fit inside the fibers, which show protuberances that could be associated with PPy particles. The chemical groups on the surface of the fibers are those of PLA, which suggests that the particles are inside the fibers.

Keywords: PPy Plasma, Electrospinning, PPy-PLA, Composite Fibers

1. Introduction

It has been reported that polylactic acid fibers covered with polypyrrole synthesized by plasma (PPy) promote cell growth in-vitro. PPy synthesized in this way shows a high grade of insolubility [1-4], which difficult the formation of electrospinned fibers with it. An alternative to solve this problem is to synthesize very small particles of PPy to disperse them in polylactic acid (PLA) and to electrospin the resulting dispersion to obtain micrometric fibers of PLA with PPy particles inside. The objective of this work is to obtain this kind of fibers.

2. Methodology

PPy particles were synthesized with glow discharges at 13.56 MHz and 60 W in a cylindrical reactor. The particles were subsequently added to a solution of PLA dissolved in acetone. The resulting dispersion was electrospinned with distance between electrodes of 12 cm, roll rotation of 2500 rpm and injection speed of 1 mL/h. Morphological analysis of particles and fibers were carried out in a Jeol IT-100 scanning electron microscope. The diameters were processed with the Olympus Measure IT program. The chemical analysis was performed with a Thermo Scientific iD5 infrared spectrometer in ATR mode.

3. Results and Discussions

Figure 1 presents two micrographs of PPy particles and PPy/PLA fibers. Figure 1 (a) shows agglomerated particles of quasi-spherical shape with diameter in the 0.12-1.2 μ m

interval with mean of 0.3 μ m, see Figure 2. Figure 1 (b) shows the PPy/PLA fibers with diameter from 0.22 to 12.91 μ m with mean of 1.4 μ m and PLA/PPy average diameter ratio of 4.66. The fibers have protuberances that could indicate that the PPy particles are inside.

Figure 3 shows IR-ATR spectra of PLA, PPy particles and PPy/PLA fibers. The spectra of PLA and fibers are very similar, which suggests that the exterior of the fibers is PLA and that the particles could be submerged inside. The chemical groups found in the IR analyses are tagged in Figure 3.



a) PPy particles



b) PPy/PLA fibers **Figure 1**. Morphology of PPy particles and PPy/PLA fibers. The fibers have protuberances that suggest particles inside.



Figure 2. Diameters of PPy particles and PPy/PLA fibers.



Figure 3. IR scans of PPy particles and PPy/PLA fibers. PLA and PPy/PLA fibers have practically the same IR absorption which suggests that the PPy particles could be submerged in PLA.

Conclusions

PPy quasi-spherical particles were synthesized with average diameter of 0.3 μ m and PLA fibers with PPy particles inside with average of 1.4 μ m. The fibers have protuberances that suggest that the particles are submerged in PLA. The chemical groups of the fiber surface do not show the functional chemical groups of PPy which suggest also that he exterior is only PLA. These fibers have potential application in the growth of biological tissues due to its PPy content.

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4. References

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