Controllable Synthesis of Nanostructures of Polymers of Aniline

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Keywords: *nanoscience, aniline, polyaniline, conducting polymer, synthesis.*

Introduction

An organic polymer that possesses the electrical, electronic, magnetic and optical properties of a metal while retaining the mechanical properties, processibility, etc. commonly associated with a conventional polymer, is termed an "intrinsically conducting polymer" (ICP) more commonly known as a "synthetic metal"[1]. Its properties are intrinsic to a "doped" form of the polymer. This class of polymer – an electronic polymer – is completely different from "conducting polymers" which are merely a physical mixture of a nonconductive polymer with a conducting material such as a metal or carbon powder distributed throughout the material.

We have demonstrated for the first time[1] that nanofibers of polymers of aniline, polyaniline in the emeraldine oxidation state[2], can be obtained without the need of adding an external template (soft or hard) to the polymerization system or the use of interfacial polymerization[3].

A basic purpose of this research is to blend the now well-established field of electronic conducting polymers with the new, emerging field of nanoscience to produce the hybrid field of "nanoelectronics" involving novel nano/micro structures of electronic polymers which are significantly smaller than the diameter of a human hair (~50,000 nm).

Results and Discussion

Our very recent studies[4] show that the pH of the system involving the aqueous oxidative polymerization of aniline has a large influence on the resulting nanomorphology and indeed on the actual chemical composition of the polymer of aniline produced. For example, at pH 3-4, self-assembled hollow microspheres composed of what we believe is an unusual type of polymer (Av. M_w = 4081, Av. M_n = 3,778, polydispersity index = 1.08), is formed spontaneously in the aqueous medium.

Figure 1 presents different types of morphology obtained by conducting the aqueous oxidative polymerization of aniline in an aqueous medium under different experimental conditions. The novelty of this work is to present a simple and straightforward method to obtain different nano/micro structures of polymers of aniline without the need of the using an external template (soft or hard). We are able to synthesize nanofibers of polynailine with high yield (> 90 %) and nano/microspheres (> 80 %). The synthesis of nanotubes of polymers of aniline is under investigation in order to improve the yield of nanotubes-like structures in the final product of the polymerization reaction.

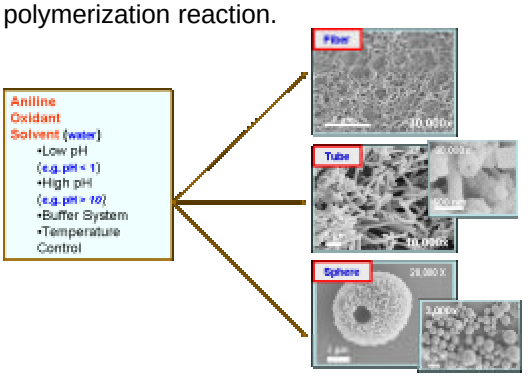

Figure 1. Nanostructures of polymers of aniline.

Conclusions

The control of the morphology of polymers of aniline strongly depends on the experimental conditions used to conduct the oxidative polymerization of aniline. The parameters such as initial pH and absolute concentration of reactants as well as the molar ratio between reactants are very important. Relatively high initial pH (pH > 4) and relatively low concentration of reactants favors the formation of nano/micro spheres (solid and hollow). Low initial pH values favor the formation of nanofibers.

The formation of nanotubers is under investigation. The preliminary results indicate that the formation of these nanostructures occurs at relatively high initial pH (pH>4) and relatively low temperatures (~ 0 ^{o}C).

Acknowledgements

Studies described were supported by The Nanotechnology Institute (Pennsylvania), Department of Energy (USA), University of Pennsylvania and University of Texas at Dallas.

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