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Stabilizer-free conducting polyaniline nanofiber aqueous colloids and their stability

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Abstract

Stabilizer-free polyaniline nanofiber aqueous colloids were obtained by the direct dispersing of polyaniline nanofiber prepared in the presence of β-cyclodextrin. The polyaniline nanofiber, the diameters of which are between 80 and 100 nm, can be steadily dispersed in near neuter (pH = 6.5) aqueous solution for about 60 days without any steric or electrostatic stabilizer.
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1. Introduction

Polyaniline is one of the most useful of the conducting polymers due to its facile synthesis, environmental stability and simple behavior of chemical doping/dedoping, and can be readily prepared in bulk by the chemical oxidative polymerization of aniline under controlled conditions [1–3]. Compared with granule polyaniline synthesized by conventional chemical methods, nanostructure polyaniline exhibits superior chemical sensing and unique photothermal effect [4–6]. In order to exploit further the fundamental properties of nanostructure polyaniline and their applications, the processability of the nanostructure polyaniline in both bulk and thin film has attracted more and more attentions. The preparation of colloidal dispersions is an effective way for improving the processability of the intractable polyaniline. D. Li and Kaner [7] have found that the polyaniline aqueous colloids could be obtained by purifying chemically prepared polyaniline nanofiber and controlling pH. The stable polyaniline nanofiber aqueous colloids can be formed at around pH = 2.6 through electrostatic repulsion without any chemical modification or steric stabilizer. My group [8] also reported a novel method for the synthesis of self-dispersible conducting polyaniline nanofiber, which was prepared by the oxidative polymerization of aniline in the presence of β-cyclodextrin as a dopant. Self-dispersible conducting polyaniline nanofiber can be dispersed in the range of pH = 3 to pH = 6.5 aqueous solution for 10–20 days. A great improvement of the processability would significantly impulse the applications of conducting polyaniline nanofiber in chemical sensing, actuators, lightweight battery electrodes, light-emitting devices and antistatic coatings.

Recently, we found that the dried process, especially the temperature and speed of dryness, affected the wettability of conducting polyaniline nanofiber. Conducting polyaniline nanofiber that was dried by the different ways had different wetting angles. And the wetting angle rightly influenced the dispersion of conducting polyaniline nanofibers in the aqueous solution. The results showed that high temperature and quick dryness were disadvantages to the dispersion of polyaniline nanofiber. Herein, we directly dispersed the conducting polyaniline nanofiber without being dried in the near neuter (pH = 6.5) aqueous solution, and obtained the polyaniline nanofiber aqueous colloids. The aqueous colloids can be kept stable for about 60 days without any steric or electrostatic stabilizer. The significant stability of conducting polyaniline aqueous colloids may impulse their applications in many fields.

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