EFFECT OF ZnO NANOPARTICLES ON DIAMETER OF BUBBFIL PVA/ZnO NANOFIBERS

by

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Short paper
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The PVA/ZnO nanofibers are obtained by the bubbfil spinning. Distribution of fiber size is tenable by nano-ZnO concentration. Experiment reveals fiber size distribution changes from Gaussian distribution to Poisson distribution when ZnO concentration varies gradually from 2 wt.% to 15 wt.%.

Key words: *bubble electrospinning, bubbfil spinning, polyvinyl alcohol, nano-ZnO*

Introduction

The nanofibers have many fascinating properties and wide applications in many fields, such as sensor technology, catalysis, filtration, and medicine [1]. Bubbfil spinning is an excellent method to fabricate nanofibers with extremely high throughout [2-4]. Polyvinyl alcohol (PVA) is water-soluble and has good fiber forming ability, biocompatibility, chemical resistance, and biodegradability. The PVA can form gels with various solvents and co-solvents. All these properties make PVA suitable for medical, cosmetic, food, pharmaceutical, and packaging applications [5]. In this research, we prepare several PVA/nano-ZnO mixtures with different nano-ZnO concentrations to study the effect of ZnO concentration on fiber size distribution.

Experimental

The PVA with a degree of 1750 ± 50 was dissolved into distilled water at room temperature, then the mixture was stirred with the aid of electromagnetic stirrer at 90 °C to get homogeneous and transparent solution, and cooled to the room temperature. The PVA concentration was 7 wt.%. Some nano-ZnO particles were added gradually into the PVA solution. By this method, we prepared several nano-ZnO/PVA mixtures with nano-ZnO concentrations of 2, 5, 10, and 15 wt.%, respectively. The mixed solution was then put into the ultrasonic cell disruption system to make them homogeneously mixed. Then the mixture was stirred with the aid of electromagnetic stirrer until used to produce nanofibers in bubbfil spinning devices. Nano-ZnO

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particles were obtained as a white colloidal dispersion in the PVA solution. The bubbfil spinning experiments were performed at room temperature. The applied voltage and the solution surface to collector distance were fixed at 30 kV and 25 cm, respectively.

Results and discussions

The morphology of the bubbfil-spun nanofibers were observed by scanning electron microscopy (SEM), fig. 1. The nanofiber diameter size distribution of the bubbfil-spun nanofibers was drawn by the Origin software, see fig. 2. It is shown that the nanofiber diameter size distribution with 2 wt.% of ZnO nanoparticles is almost Gaussian distribution, however, the fiber size distribution changes to Poisson distribution with an increasing parameter $\lambda > 0$ when ZnO concentration increases as shown in fig. 2.

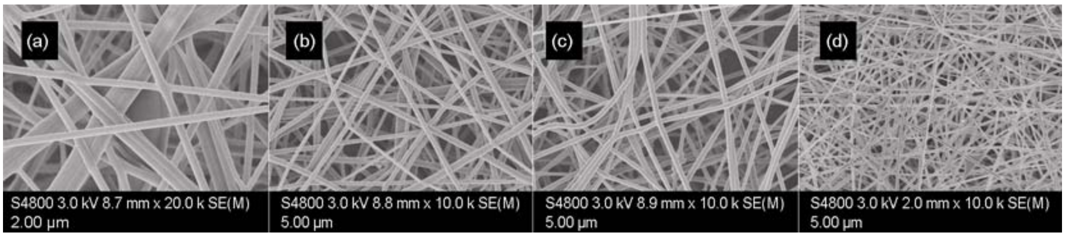

Figure 1. The SEM illustrations of bubbfil-spun PVA/ZnO nanofibers with differential concentrations of ZnO nanoparticles; (a) 2 wt.%, (b) 5 wt.%, (c) 10 wt.%, (d) 15 wt.%

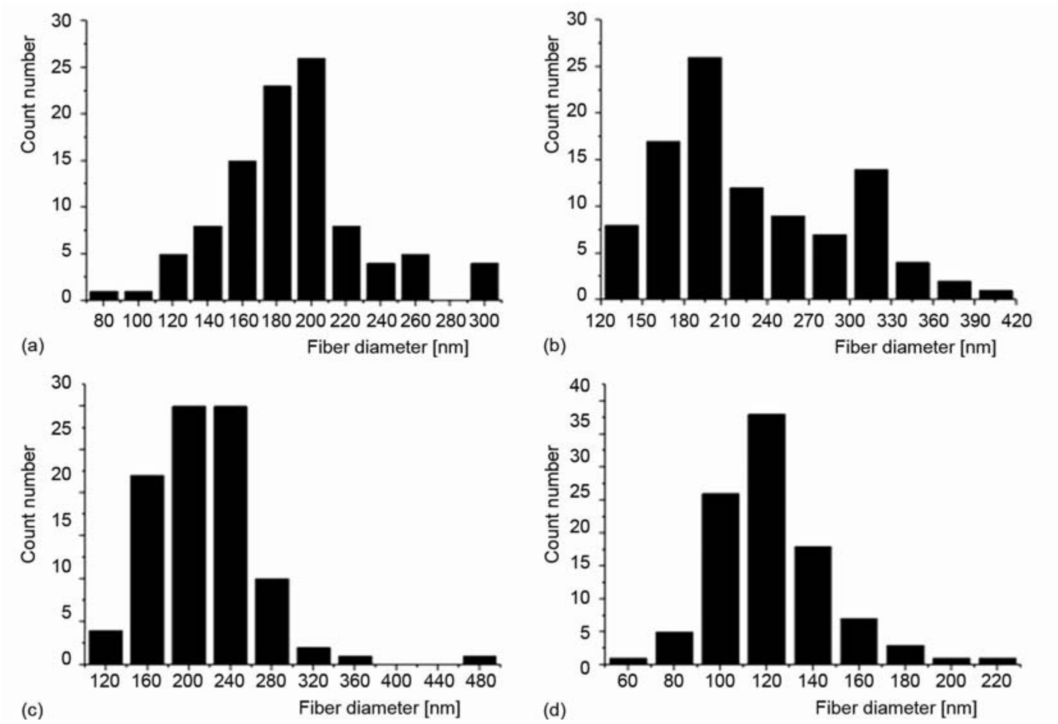

Figure 2. Fiber size distribution with differential concentrations of ZnO nanoparticles; (a) 2 wt.%, (b) 5 wt.%, (c) 10 wt.%, (d) 15 wt.%

The probability distribution for average diameter of fibers is illustrated in fig. 3.

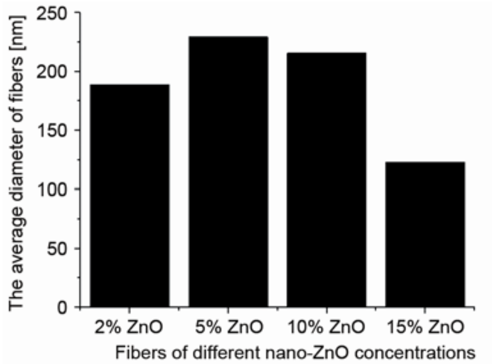

Figure 3. Fiber size distribution

Conclusions

The PVA/nano-ZnO nanofibers are fabricated through bubbfil spinning. This experiment shows that the probability distribution of fiber diameter mainly depends on the ZnO concentration.

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