THERMAL PERFORMANCE OF CELLULOSE ACETATE/TEA POLYPHENOL NANOFIBERS

by

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In this paper, the cellulose acetate/tea polyphenol nanofibers are manufactured by electrostatic spinning technique. The surface morphology and thermal property of obtained nanofibers are characterized via scanning electron microscope, thermal gravity analysis, and differential scanning calorimetry. Different concentrations of cellulose acetate/dimethyl formamide solutions are prepared before sonicated tea polyphenol powder was added. The diameter of cellulose acetate/tea polyphenol nanofibers increases with the increase of the cellulose acetate component.

Key words: *thermal performance, cellulose acetate, tea polyphenol, nanofiber*

Introduction

Nanofibers made with electrostatic method [1, 2] have attracted more and more attentions due to their huge specific surface area and unique performance which show a great prospect of applications. Tea polyphenol (TP) is a famous antioxidant and antiseptic product which has great development potential in medicine, health care, cosmetics, and other industries. Cellulose is the world's most abundant biopolymer and a linear polysaccharide consisting of repeated D-glucose [3]. Cellulose and cellulose derivatives nanofibers made by electrospinning were reported in various literature [4-6]. Cellulose acetate (CA) is one of the most common cellulose derivatives. To take the advantage of both TP and CA fibers we herein dissolve them into the dimethyl formamide (DMF) solvent to produce CA/TP nanofibers. To the best of our knowledge this has not been investigated so far.

Experimental

The CA used in the current study was obtained from Aladdin company, with a 39.8 wt.% acetyl content and a 3.5% wt.% hydroxyl content. The CA powder was first put into anhydrous ethanol and stirred with a magnetic stirrer for 20 minutes at room temperature. The TP powder was dissolved in DMF solvent and disintegrated in a sonifier cell disrupter for 10 minutes. Final spun solution was obtained by mixing these two solutions and stirred with a magnetic stirrer in a water bath for 20 minutes at 60 °C. Different concentrations of CA/TP spun solutions were prepared to investigate the influence of concentration on the nanofiber diameter.

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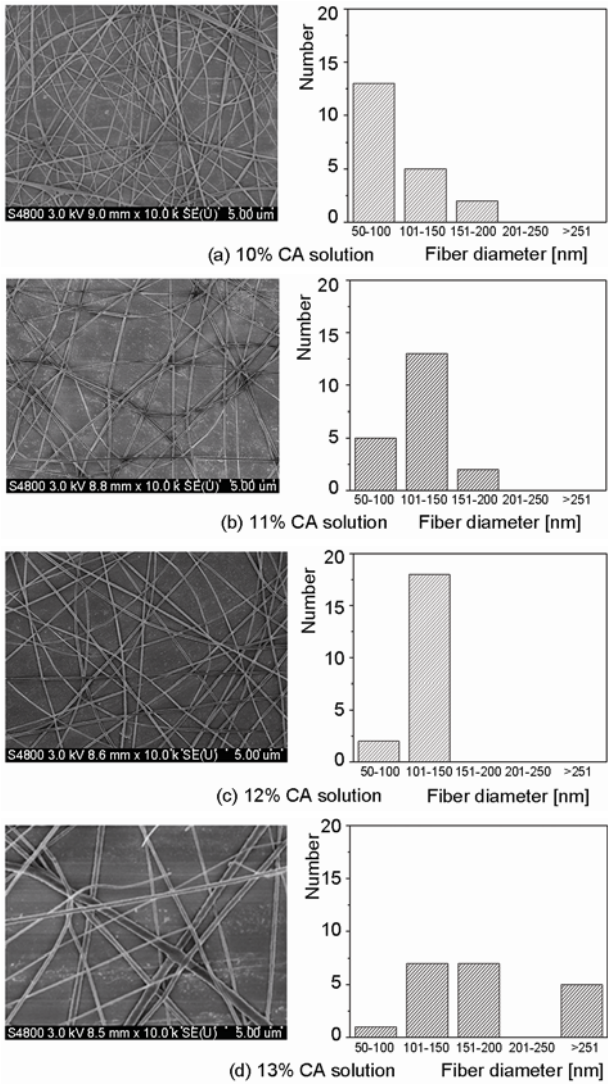

Figure 1. The diameter of CA/TP nanofibers made by different CA concentrations

Electrostatic spinning was performed using a syringe capped with a blunt needle (internal diameter of 0.5 mm), a high voltage (30 kV in our study) was applied to the needle tip. The distance between the needle tip and grounded collector which was covered with an aluminum foil was 17 cm. The flow rate of the solution was set as 0.1 mL per hour. To control the environment, the electrospinning setup was put into the laboratory with constant temperature of 20 °C and constant relative humidity of 65%.

Results and discussions

Figure 1 shows the surface morphologies and diameter distributions of CA/TP nanofibers obtained by different concentrations of CA. The average diameters of CA/TP nanofibers increased with the increase of the concentration of CA. This is mainly due to the increase entanglement of the molecular chains when the concentration increases.

The weight retention ratio and heat flow of the CA/TP nanofibers is shown in fig. 2. The thermal characters of the CA/TP nanofibers can be divided into two stages, 210 °C ~ ~ 340 °C and 455 °C ~ 550 °C. In the range of 210 °C ~ 340 °C, the weight of CA/TP nanofiber has an obvious loss with an endothermic peak which is caused by the melting of the CA. In the range of 455 °C ~ 550 °C, the weight of the CA/TP nanofibers experiences another loss after a comparatively stable period with the second endothermic peak which is due to the thermal decomposition of CA.

Conclusions

In present study, the surface morphologies, diameter distributions, and thermal characters of CA/TP nanofibers are reported. It can be concluded that the CA/TP nanofibers show a pleasant spinnability for the concentration of CA in the range of 10%-13%. The surface of the obtained nanofibers is smooth and even. The diameter of obtained CA/TP nanofibers increases with the increase of the concentration of CA. This research provide a feasible method to produce CA/TP nanofibers which have a huge potential applications.

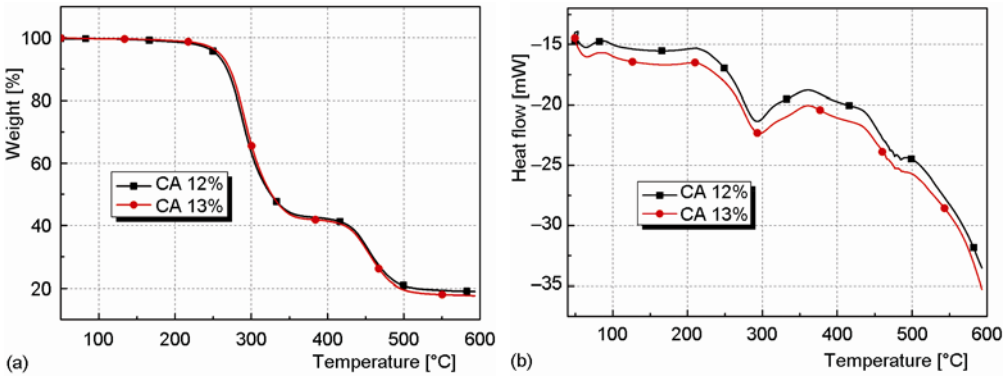

Figure 2. (a) The weight retention ratio, (b) The heat flow of CA/TP nanofibers

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