Study the Effect of the High Voltage on The preparation of Polyvinyl Alcohol/ Tio_2 Nano Fiber by Electrospinning

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Abstract

In this research we prepared nanofibers by electrospinning from poly (Vinyl Alcohol) / TiO_2. The spectrum of the solution (Emission) was studied at 772 nm. Several process parameter were Investigated as concentration of PVA, the effect of distance from nozzle tip to the grounded collector (gap distance), and final the effect of high voltage. We find the optimum condition to prepare a narrow nanofibers is at concentration of PVA 16gm, the fiber has 20nm diameter.

Keywords

Polyvinyl Alcohol/ Tio_2 Nano Fiber

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دراسة تأثير الفولتية على عملية تحضير النانوفايبر من بولي فنيل الكحول وTiO_2 بطريقة البرم الالكتروني

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الخلاصة

في هذا البحث تم تحضير نانوفايبر بطريقة البرم الالكتروني من بولي فنيل الكحول وTiO_2 . تمت دراسة طيف الانبعاث وكانت قمت الانبعاث عند 772 nm, المسافة بين نقطة الضخ و المستقبل المتصل بالأرضي وأخيرا تأثير الفولتية. أن القيمة مثلى لتركيزالبوليمرPVA من أجل الحصول على نانوفايبر بقطر 20 nm هي 16gm\L

Introduction

Nanofibers prepared by electrospinning have several advantages, such as large surface area to volume ratio, high specific surface area and small pore size, superior mechanical properties and flexibility in surface functionalities [1].

The principle of electrospinning is to apply high voltage on syringe needle which is connected to a syringe which contains polymer solution container. When polymer solution flows out from needle, the polymer is pulled onto collector by strong electric field and forms nanofibrous structure, based on our pending patent. We built our own setup of electrospinning and prepared poly (vinyl alcohol) / TiO_2 nanofibers by electrospinning and investigated several process parameters such as concentration, gap distance. TiO_2

nanoparticles decompose harmful organic compounds.

The diameter of electrospinning nanofibers are dependent on a number of processing parameters that include:-

a- The intrinsic properties of the solution such as the type of polymer and solvent, polymer molecular weight, viscosity (or concentration), elasticity, conductivity, and, surface tension [2-7].

b- The operational conditions such as the applied voltage, the distance between spinner and collector (tip – target distance), and the feeding rate of the polymer solution [5,8].

c- In addition to these variables, the humidity and temperature of the surrounding may also play an important role in determining the diameter of electrospinning nanofibers. For instance, the polymer solution must have a concentration high enough to cause polymer entanglements yet not so high that the viscosity prevents polymer motion induced by the electric field.

The structure, based on our pending patent. We built our own setup of electrospinning and prepared poly (vinyl alcohol) / TiO_2 nanofibers by electrospinning and investigated several process parameters such as concentration, gap distance. TiO_2 nanoparticles decompose harmful organic compounds.

The diameter of electrospinning nanofibers are dependent on a number of processing parameters that include:-

a- The intrinsic properties of the solution such as the type of polymer and solvent, polymer molecular weight, viscosity (or concentration) solution must be also have a surface tension low enough, a charge density high enough, and viscosity high enough to prevent the jet from collapsing into droplets before the solvent has evaporated [4,5,6,8].

Experimental

1- Material:

a- Poly (vinyl alcohol) PVA with Mw = 14.000; viscosity of 4% aqueous sol. At 20 C; is made in USA with degree of hayrolysis (98.5 - 100) % and residual polyvinylacetute 0 to 3%.

b- Photo catalyst TiO_2 (titanium oxide) nanoparticle, TiO_2 – anatase, 98% pure, APS : 50 nm, made in Canda.

Components contents PPM

AL ≤ 20
Ca ≤ 75
Mg ≤ 65
Nb ≤ 119
S ≤ 165
Si ≤ 102

Analytical Technique: X-ray Fluorescence Spectroscopy.

2- procedure:

PVA solutions were prepared by dissolving PVA into distilled water at 80^{o}C, PVA / TiO_2 nanoparticale solutions were prepared by adding (12,14,16)gm of PVA and 0.2gm of TiO_2 nanoparticale solution into 100 ml of PVA solution respectively, and will mixed at room temperature.

Electrospinning apparatus as shown in fig. (1) Which used in this study consist of high voltage power supply, syringe, syringe needle and collecting plate (collector). The distance between syringe needle and collecting plate is adjustable. The collecting plate is connected to ground. The syringe needle is connected to solution can be pulled by strong electric field toward collecting plate and solidified on the plate to form nanofibrous structure.

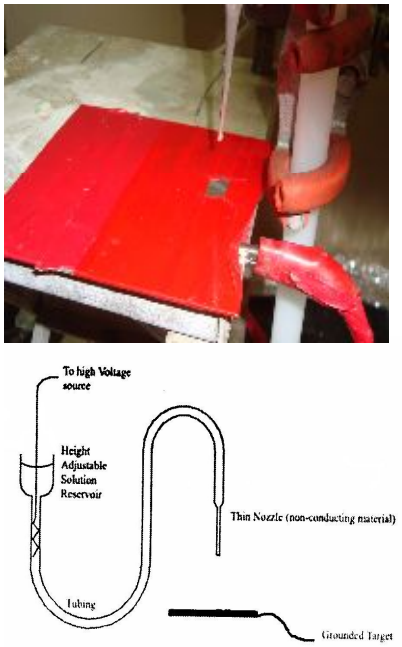

Figure (1): A- Electrospinning apparatus.

The solution prepared above was put into syringe for electrospinning at room temperature. In this paper, we only changed thePVA of the solution and the distance between the syringe needle and collecting plate (d=1-2) cm. Scanning microscopy were used to measured the diameter of nanofiber

Result and Discussion

We study in emission spectrum of PVA which illustrated.

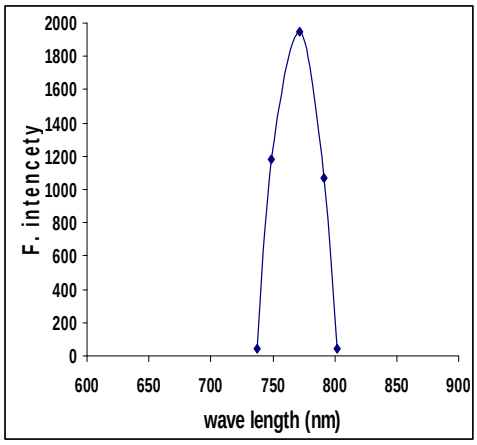

Fig.(2) show the relation between the F. intensity and wavelength for polymer PVA.

And we can see from table 1 that the optimum condition to obtain a narrow nanofiber (20nm diameter) is at concentration of 16 gm PVA / 0.2gm TiO_2, 2.2 cm the distance between the syringe needle and collecting plate, the high voltage is 30kV and this agreement with Yu-Hsun Nien et al[1].

Table 1: the relation between high voltage , the diameter of nanofibers with different condition at solvent H_2O (100ml) and temp. 26C^o.

PVA (gm)	Distance (Cm)	Dimeter (µm)	Power supply (Kv)
12	**2**	**0.04**	**30**
12	**2**	**0.04**	**25**
12	**1.5**	**0.08**	**15**
12	**1.5**	**0.09**	**20**
12	**1**	**0.08**	**25**
12	**1**	**0.08**	**30**
12	**1.2**	**0.08**	**15**
16	**1.5**	**0.06**	**20**
16	**2.2**	**0.02**	**30**
16	**1.3**	**0.08**	**20**
16	**2**	**0.02**	**30**
16	**1.5**	**0.06**	**25**
16	**1**	**0.09**	**20**
16	**1**	**0.09**	**15**
14	**2**	**0.04**	**25**
14	**2**	**0.04**	**30**
14	**1.5**	**0.06**	**20**
14	**1.5**	**0.07**	**15**
14	**1**	**0.08**	**30**
14	**1.2**	**0.08**	**25**
14	**2**	**0.04**	**10**

Conclusions

PVA/TiO_2 nanofibers have been prepared and characterized. Several process parameters have been investigated as follows: (1) the high concentration of poly(vinyl alcohol PVA), the smaller the diameter of nanofibers is, (2) increasing voltage of electrospinning lead to small diameter of nanofibers.

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