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 and found to be at 772 nm, several process parameters were such as concentration of TiO_2 , and the effect of distance from nozzle tip to the grounded collector (gap distance). The result of the lower concentration of, the smaller the diameter of nanofiber is. Increasing the gap distance will affect nanofibers diameter.

Keywords

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Nano Fiber

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تحضير بولي فنيل الكحول \TiO_2 نانوفايبر باستخدام طريقة البرم الالكتروني

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الخلاصة

في هذا البحث تم تحضير نانوفايبر باستخدام طريقة البرم الالكتروني من مزيج مادة بولي فنيل الكحول\ TiO_2 .تمت دراسة طيف الانبعاث وكانت قمت الانبعاث عند 772 nm وكذلك تمت دراسة تأثير تركيز البوليمر , المسافة بين نقطة الضخ و المستقبل المتصل بالأرضي وتأثير قيمة الفولتية العالية المسلطة .أن القيمة مثلى لتركيزالبوليمرPVA من أجل الحصول على نانوفايبر بقطر 20 nm هي 16gm\L.

Introduction

Electrospinning is an old polymer processing technique that has recently been rediscovered. It allows for the easy creation of nanofibers that can be collected to fabricate novel structures for varies application including tissue engineering, clothing, drug delivery vehicles, and filtration media [1].

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 [2].

The principle of electrospinning is to apply high voltage on a syringe needle which is connected to a syringe containing polymer solution. When the polymer solution flows out from needle, it will be

pulled onto collector by a strong electric field and so famines nanofibrous structure, based on our pending patent. We built our own setup of electrospinning was built. Poly (vinyl alcohol)/TiO_2 nanofibers by electrospinning were prepared to investigate several process parameters such as concentration, gap distance.

TiO_2 nanoparticles decompose harmful organic compounds.

The diameter of electrospinning nanofibers depends 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 [3-8].

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 [6, 9, 10].

c- In addition to these variables, the humidity and temperature of the surroundings may also play an important role in determining the diameter of electrospinning nanofibers [11]. 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 solution must 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 [5, 6, 7, 9].

Experimental

1. Material:

a- Poly (vinyl alcohol) PVA & Mw= 14.000 and 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, TiO2 – anatase, 98% pure, APS:50nm, made in Canda.

Analytical Technique : X-ray Fluorescence Spectroscopy.

2. procedure:

PVA solutions were prepared by dissolving PVA into distilled water at 80°C, PVA / TiO_2 nanoparticale solutions were prepared by adding 0.05g and 0.1g of TiO_2 nanoparticale solution into 100 ml of PVA solution respectively, and well mixed at room temperature.

Electrospinning apparatus (fig. (1)) 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.

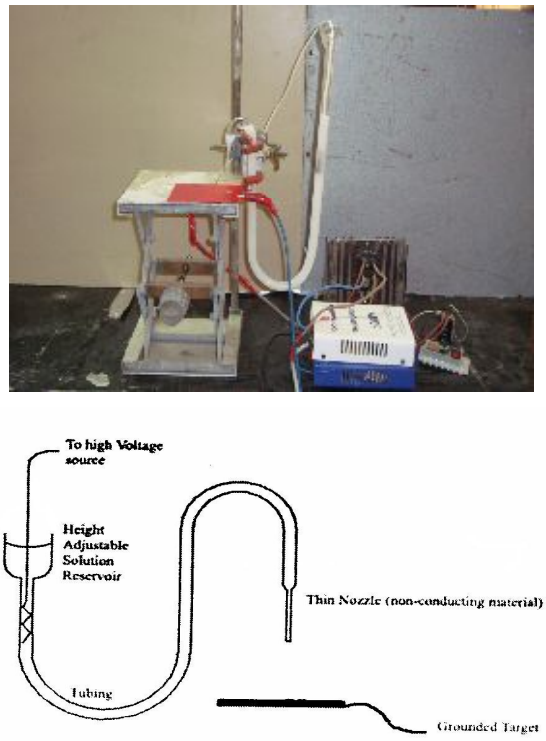


Figure (1) –A- Electrospinning apparatus.

The solution prepared was put into a syringe for electrospinning at room temperature. theTiO2 viscosity of the solution (0.1, 0.2) M and the distance between the syringe needle and collecting plate (d=1-3) cm. Scanning electron

microscopy, beam engieers (INDA), trinocular metallurgical microscope, model: beam rmm-7t (2003).

Result and Discussions

The diameter of the samples is about 429nm for a concentration 0.1M TiO2 , and vary from (793-61) nm for concentration 0.2 M TiO2 as illustrated in table1.Figure (2) show the relation between the diameter of the nanofiber and the distance between the syinge and collecting plate (d).

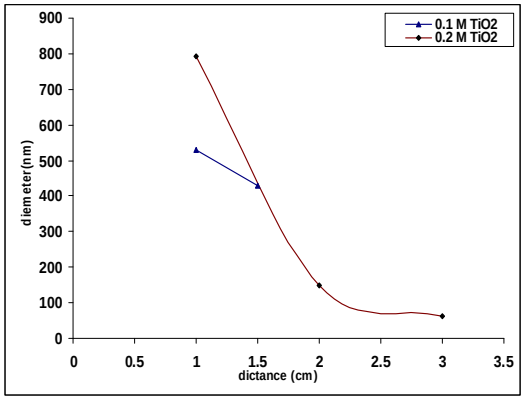
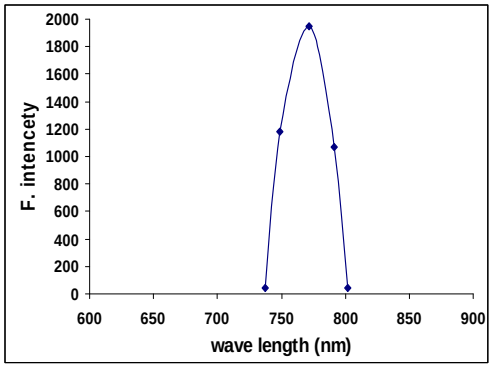


Figure (2) the relation between the diameter of nanofiber and the distance between the syinge and collecting plate (d) with different concentration of TiO_2

From the above figure and table 1 the diameter of nanofiber decreases as the concentration of TiO2 solution with PVA decreases (i.e.) the higher concentration of the solution tends to increases the diameter, this concentration of TiO2 solution is very low, the polymer chains may not aggregate enough to construct stable nanofiber however, TiO2 nanoparticles show well distribution in PVA nanofiber matrix.

The emission spectrum of PVA is studied which is illustrated in fig.2.

From the wave length emission 772 nm, that we can cross wavelength crossbonding the emission beam for polymer PVA.

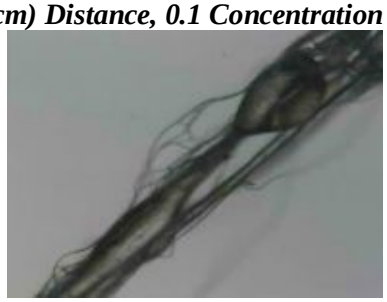


Figure(3) the relation of emission spectrum of PVA solution

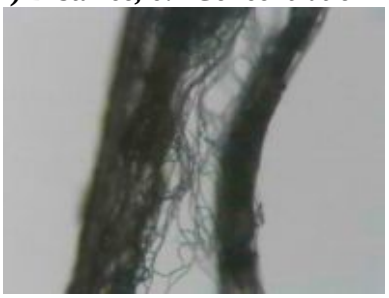
From this figures we can see the nanofibers which from this methods.

3 (cm) Distance, 0.2 Concentration TiO2

1.5 (cm) Distance, 0.1 Concentration TiO2



1 (cm) Distance, 0.2 Concentration TiO2



2 (cm) Distance, 0.2 Concentration TiO2

Figure (4) shows the SEM of the samples which prepared for distances and concentration.

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