The Effect of Some Parameter morphologies for Poly (vinyl alcohol) fiber by electrospum method

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Abstract

The present work is study some parameters which affected on the fiber formation of polymer (PVA), nanofibers have been prepared by using an electrospinning method, by using different concentration and the applied voltage and the gap length were changed. It was observed that the fiber diameter change with the applied voltages influence , the polymer concentration and the distance change between the electrodes.

Key words: nano-microfibers, electrospinning method , (PVA).

تأثير بعض معلمات الطبغرافية لبولي فنايل الكحول المحضرة بطريقة الغزل الكهربائي

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الخلاصة

تم في هذا البحث دراسة بعض المعلمات التي أثرت على تشكيل الألياف البوليمر بولي فنايل الكحول , الألياف النانوية حضرت بطريقة البرم الكهربائي وذلك باستخدام تراكيز مختلفة والجهد المطبق وطول الفجوة تم تغييرها . لوحظ

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أن التغيير قطر الألياف مع تأثير الفولتية المطبقة، وتركيز البوليمر وتغيير المسافة بين الأقطاب. حيث نجد تغير قطر الليف يتغير بتغير كل من التركيز الفولتية المسلطة والمسافة بين الاقطاب .

الكلمات الدالة: الياف نانوية , طريقة البرم الكهربائي, بولي فنايل الكحول.

Introduction

Academic and industrial research on nanofibres is an area of intense global interest in terms of both fundamental and applied science. Nanofibers due to their extremely high surface to volume ratio compared with conventional fibers exhibit special properties such as low density, low specific mass and high pore volume which make them appropriate for a wide range of applications[1,2]. Electrospinning is an extensively studied and widely applied method for nanofibre production from a remarkable range of organic and inorganic materials. Thetechnique has enjoyed significant attention since the 1990s [3]. Electrospinning has gained popularity in the last (10) years due in large part to an increased interest in Nano scale properties and technologies. This technique allows for the production of polymer fibers with diameters varying from 3 nm to greater than (5µm) Potential applications of electrospinning include filtration membranes, catalytic nanofibers, fiber-based sensors, and tissue engineering scaffolds[4,5].

During the electrospinning process, a polymer solution is held at a needletip by surface tension. The application of an electric field using the high-voltage source causes charge to be inducedwithin the polymer, resulting in charge repulsion within the solution. This electrostatic force opposes the surface tension; eventually, the charge repulsion overcomes the surface tension, causing the initiation of a jet. As this jet travels, the solvent evaporates and an appropriate collectorcan be used to capture the polymer fiber[5]. On account of its versatility and economic competitiveness at the laboratory scale for producing nanofibres and composite nano-structures with tuneable properties for a broad range of applications. From photocatalytic self-cleaning car mirrors and building materials, stain-repellent, wrinkle-free, highlybreathable detoxifying clothes,to multifunctional, stimuli responsive bioen gineered

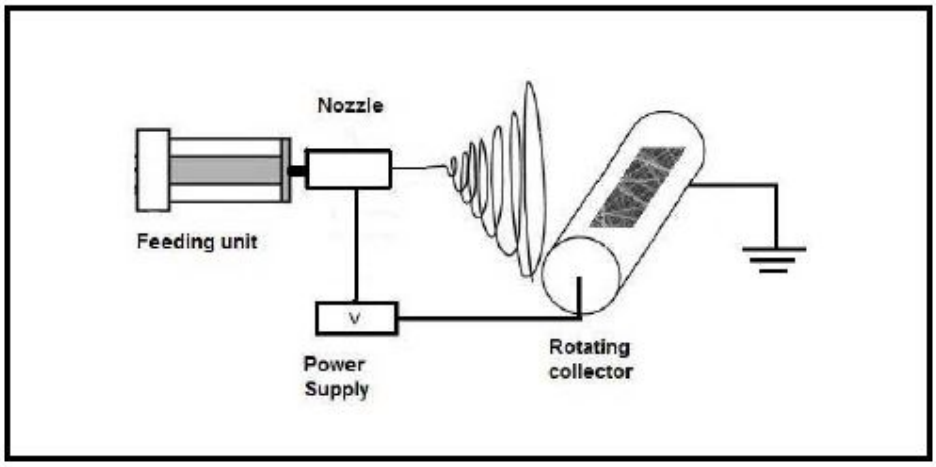
structures, and superfast miniatureelectronics, the applications of electro spun nanofibres and nano composites include not only domestic items such asclothing, batteries, optical devices, gravimetric and chemicalsensors, and biomedical and healthcare products, butalso large scale engineering on a worldwide level such asin sustainable construction, air and water filtration and purification,and energy generation using photovoltaic solarpanels. The research and application areas of electro spun nano fibres and technical textiles are expanding rapidlyand playing invaluable roles in a range of advances innano science and technology, which continue to transformour standards of living. As a result, the demand for nano fibres burgeoning[6,7].

Experimental

Poly(vinyl alcohol) (PVA) is a hydrophilic, semicrystalline polymer that attracts much attention because of its good chemical resistance, good thermal stability, good physical properties, excellent biocompatibility, and inexpensiveness. Several different forms of (PVA) such as gels, films, and nanowebs have been produced through different methods. Especially the availability of (PVA) nano fibers with high surface area to volume atio and highly porous three dimensional structure through a simple process of electrospinning introduced a new set of potential uses such as immobilization membranes for cellulase, drug delivery membranes, wound-dressings , filtration medium for oil/water emulsion, and scaffolds for tissue engineering applications[8,9] , In this research, studies that investigate the effect of each V applied voltage and (d) distance between collector and needle parameter on electrospun fiber morphologies and sizes are highlighted.

In the present work PVA, distilled water, were used. Electro spinning solutions were prepared according to the following procedures: (PVA) electro spinning solution was prepared by dissolving (0.25,0.5,0.75,1)g (PVA) in (10g) distilled water to get (0.025,0.05,0.075, 0.1 w/w %) using magnetic stirrer at 70ºC for 1 days.

Electro spinning of nano fibers was performed on a horizontal electro spinning setup as chematic design of which is illustrated in Figure (1).



Figure(1) Schematic of electro spinning setup used to producing nano fiber mats.

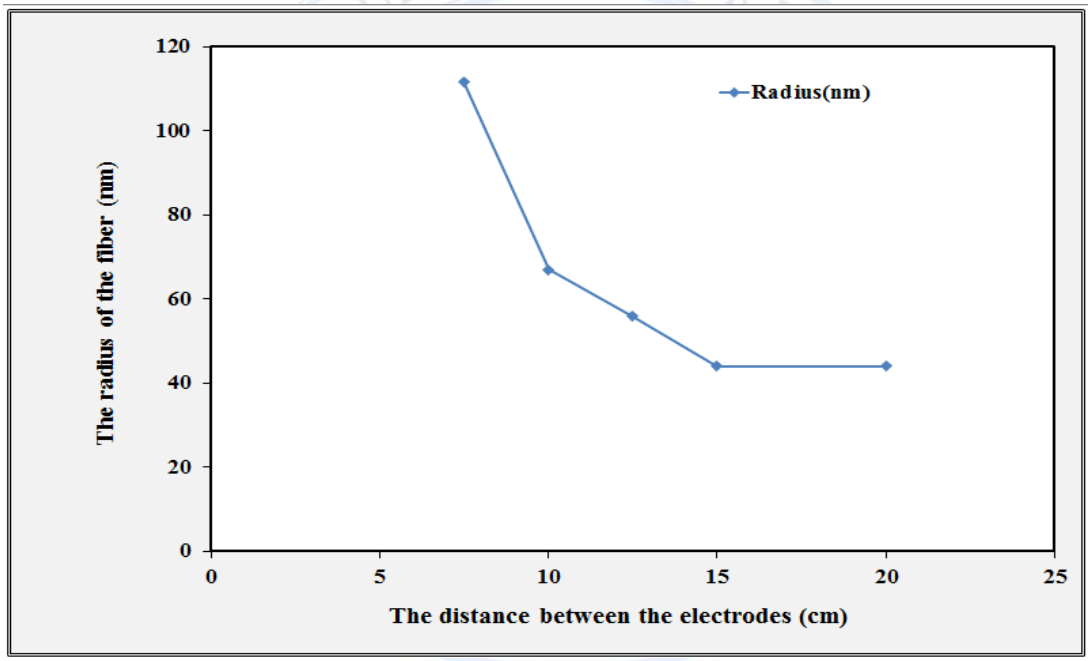
It consisted of a precisely-controlled syringe pump (homemade) using materials from the local market, a high voltage power supply capable of(0–25) kV (Phywe), and agrounded collector. Upon applying a high voltage, a fluid jet was ejected from the tip of the nozzle. As the jetaccelerated toward the collector, which was placed at (7.5, 10, 12.5,15,20) cm from the nozzle, the solvent evaporated and nanofibers were collected on the conductive collector. The electro spinning of (PVA) was conducted with anapplied voltage of (10, 15, 20) kV and a feeding rate of (0.5 ml/h), with rotatingcollector. The average diameter of the electro spun fibers was observed with a scanning electron microscope (SEM).

Results and Discussion

Many of parameters which effect on the electro spinning and then the type of fiber production depending on these parameters, for a given fluid, the electric field and flow rate affect the shape of jet. As the electric field is increased, the jet thins more rapidly and the cone region become shorter and more concave in profile[10,11] from example by some parameter we can be reduced from (35 ± 8) μm in diameter, to (840 ± 190) nm with a viscosity-reducing additive. Melt electro spun blends of poly(ethylene glycol)-block-poly(ε-caprolactone)

(PEG47-b-PCL95) and poly(ε-caprolactone) (PCL) produced fibers with micron-scale diameters (2.0 ± 0.3 μm) [12].

figure (2) shows the effect of the distance between the electrodes to change the values of fiber diameter on demonstrated all of the voltages applied to the polymer solution concentration in the solvent values as shown in table (1), as we note a decrease fiber diameter values as increase the distance between the electrodes. This due to elongation developments in fiber due to Coulomb force;which cause an increase in the length of the fiber to its diameter, leading to a narrowing of the fiber and less fiber diameter output[13].



Figure(2) the relationship between the diameter and the distance between the electrodes, certified the concentration and the applied voltages.

Table (1) Shows the values of fiber diameters for different distance, certified the applied voltages and concentrations		
Applied voltage 15(Kv)		
Concentration %	The distance between the electrodes (cm)	The diameter of the fiber (nm)
5%	7.5	111.6
	10	66.9
	12.5	55.8
	15	44
	20	44

Figure (3) shows the effect of the concentration on the diameter of the fiber on demonstrated all of the voltages applied distance between the electrodes, values as shown in table (2), as we note an increase fiber diameter values as increase the concentration . This due to incapacitate Coulomb force adverse viscosity force which cause a decrease in the length of the fiber diameter, leading to a wide of the fiber and less fiber length output [14].

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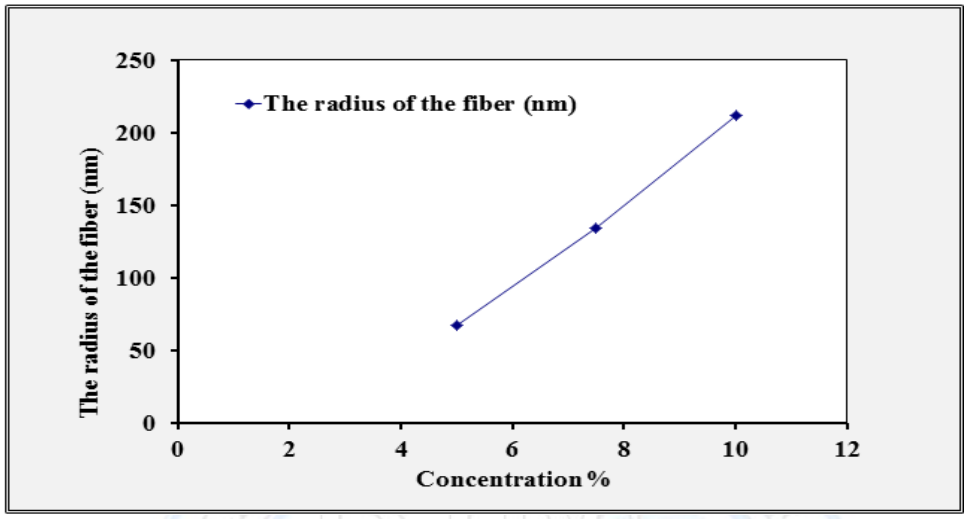

Figure (3) the relationship between the diameter and concentration, certified the distance and the voltages applied

Table (2) the values of fiber diameters for different concentrations ,certified the distance and applied voltages		
The distance between the electrodes 10 (cm)		
Applied voltage	Concentration%	The diameters of the fiber (nm)
15(Kv)	5	111.6
	7.5	134
	10	212.1

Table (3) the values of fiber diameters for different applied voltages , certified the distance and concentrations.

Table (3) the values of fiber diameters for different applied voltages ,certified the distance and concentrations		
The distance between the electrodes 10 (cm)		
Concentration%	Applied voltage(Kv)	The diameters of the fiber (nm)
10	15	212.1
	25	268

We note that the fiber diameter increases, as increase of applied voltages due to increased electrical power of attraction on the fiber without giving sufficient distance for the fiber to adequately elongates[14]

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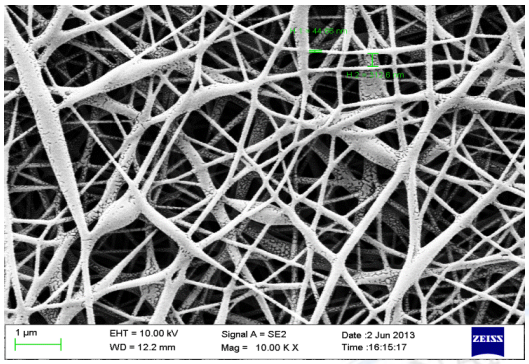
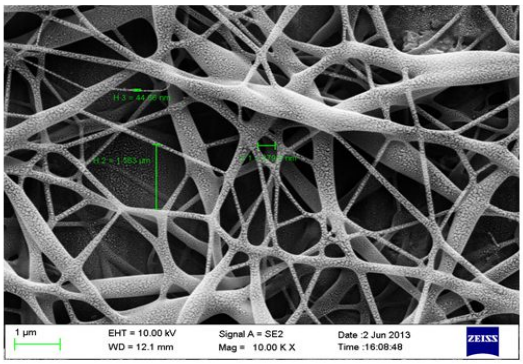
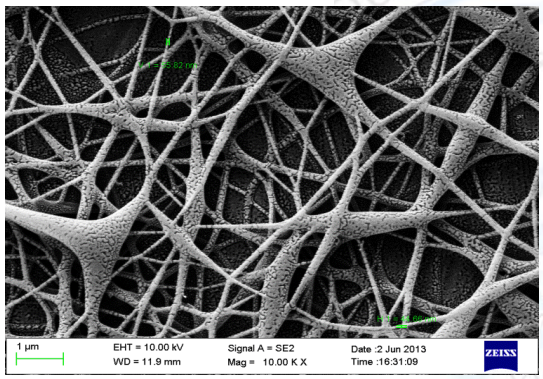


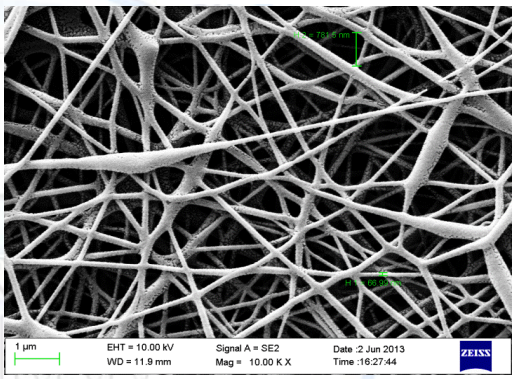
d=20 cm



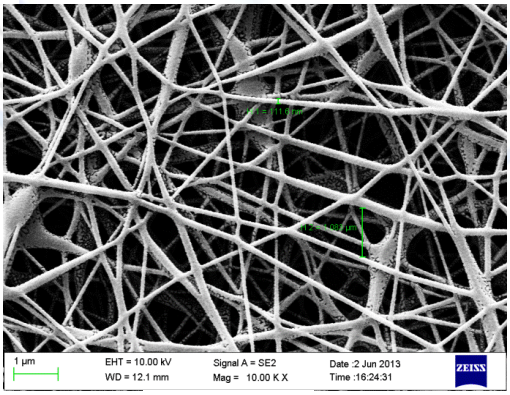
d= 15



d= 12.5



d =10 cm



d =7.5

Figure (4) the scanning electron microscope images of models prepared by installing the concentration and applied voltage, for different distances

Conclusion

(PVA) nano fibers have been prepared Successfully by using an electro spinning method . the polymer concentration and the distance change between the electrodes and It was observed that the fiber diameter change with the applied voltages influence.

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