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METHOD OF ELECTROSPINE FOR POLYMER NANO FIBERS

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Published:	April 18th 2021	The electrospin method is a necessary and useful method for the production of nano fibers. Nano-fiber production techniques are divided into: physical-synthetic (e.g., mechanical, physical combination of steam, laser and electrospination) and chemical-synthetic methods (e.g., chemical vapor deposition, hydrothermal, sol-gel, template) synthesis, and microwave synthesis and electrochemical deposition).

Keywords: Nano fibers, polymer, electrospinning, polymer solution, adhesive, synthetic, nanotechnology

INTRODUCTION.

Fibers in the form of continuous threads or elongated objects are found everywhere in nature. For more than 140 million years, spiders have relied on fiber webs to catch their prey. Silkworms are also known for their amazing ability to produce silk threads to build cocoons. These and many other natural systems have served as an important source of inspiration for the development of artificial fibers [1-3]. In fact, fiber has been a major part of human life since the dawn of civilization. The history of fiber production by mankind dates back to our history. Pieces of cotton dating back to 5000 BC were excavated, and in 2700 BC the cultivation of silkworms began for the production of silk fibers and textiles. Polymer fibers are divided into two major groups, namely natural and chemical fibers. Their formation is extremely diverse. As the first commercially available synthetic fiber, nylon was produced by DuPont in 1938 and immediately attracted public attention. Synthetic fibers significantly reduce the population's demand for natural fiber, while significantly expanding the scope of application.

One of the main challenges of nanotechnology is the production of materials with these new properties. The rapid development of modern nanotechnology and nanotechnology is closely linked to the creation of new nanomaterials, especially polymer nanoparticles with anisotropic properties using electrospin. Electrospination or electrostatic spinning is the process of producing fibrous structures in the nanometer range (40 to 2000 nm in diameter) under the influence of fluid flow [5,6].

In general, the electrospination method allows the production of continuous fibers from tens of nanometers to several micrometers [7].

THE PRINCIPLE OF FIBER-FORMING ELECTROSPIN.

The concept of electrospin was developed in a study by William Gilbert in 1600, who observed the formation of a water droplet in the form of a cone in an electric field [8]. The behavior of the charged drops was then systematically studied by Lord Rayleigh.

Electrospination involves an electrohydrodynamic process during which a liquid droplet generates electricity and forms a jet. As shown in Figure (Figure 1-A), the basic installation of the electrospin is almost simple, it can be used for almost any laboratory blunt tip and conductive collector, power supply directly to It can be current or alternating current (AC). During the electrospinning process, the liquid is squeezed out of the machine and a coral drop is formed as a result of the surface tension. During electrification, an electrostatic repulsive drop between surface charges of the same sign deforms the Taylor cone, from which a charged reagent emerges. Initially the jet is stretched in a straight line and then subjected to strong whipping movements due to bending instability. Because the jet extends into thin diameters, it hardens quickly, and this causes the hard fibers to deposit in a ground-mounted collector. In general, the process of electrospinning can be divided into four successive stages: (i) the charging of a liquid droplet and the formation of a Taylor cone or cone-shaped reagent; (Ii) extending the charged plane along a straight line; (Iii) thinning of the reagent in the presence of an electric field and an increase in the instability of the electric bending (also called whipping instability); and (IV) solidification of the reagent as solid fibers and collection in a grounded collector [9,11,12].

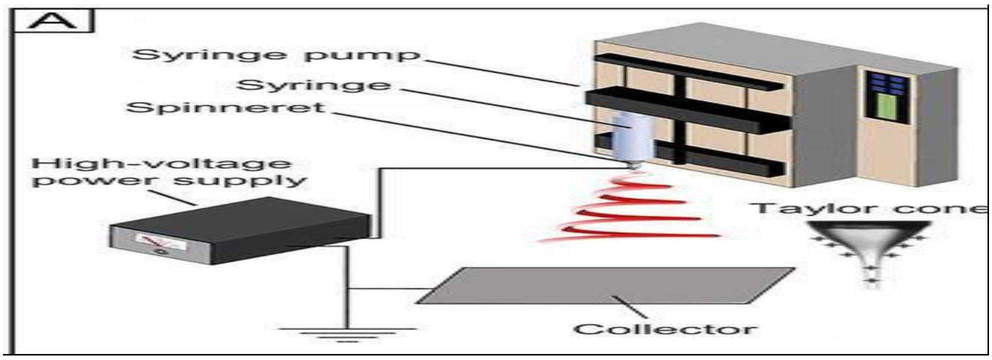

Figure 1-A. The construction of the electrospin is described.

With the help of electrospin, nano fibers are produced from different types of materials. The most commonly used materials are organic polymers in solution or solution form. Small molecules can be attached directly to the nanoparticles with an electrospun if they come together on their own and form a sufficient chain entanglement. As the tip of the polymer solution is elongated and diluted with instability, the solvent evaporates rapidly, resulting in jet solidification and deposition of solid nano fibers in the collector [12].

More than 100 different organic polymers, including natural and synthetic polymers, have been successfully studied for electrospin solution to produce nanoplasts directly. Among them, synthetic polymers such as polystyrene (PS) and poly (vinyl chloride) (PVC) have been electrospun on nanoparticles for commercial use related to environmental protection. Many biological and degradable synthetic polymers, such as PCL, poly (lactic acid) (PLA), and poly (lactic-colicolic acid) (PLGA), are electrospun directly into nano fibers and scaffolded for biomedical studied as. Natural biopolymers, such as DNA, silk fibroin, fibrinogens, dextran, chitin, chitosan, alginate, collagen, and gelatin, have also been electrospun into nanoparticles from their solutions. Conductive polymers such as polyaniline (PANi) and polypyrol (PPy) are electropunctured directly into nano fibers. Other types of functional polymers, such as poly (vinylidene fluoride) (PVDF), have also been electrospun on nano fibers for piezoelectric or pyroelectric applications.

In general, the success of polymer solution electrospinning, as well as the structure and morphology of polymer nanoplastics, is determined by a set of parameters related to the polymer, solvent, polymer solution, processing parameters, and environmental conditions [9, 10]. There are two general requirements for successful solution electroposition: (i) a sufficiently high molecular weight for the polymer and (ii) a suitable solvent for the polymer to dissolve. Very high volatility is not suitable for fiber spinning, as the reagent may solidify immediately after exiting the spinneret. If the variability is too low, the fibers will still be wet when they are placed in the collector. The dielectric constant of the solvent controls the magnitude of the electrostatic repulsion between the surface charges located in the reagent. As the dielectric constant increases, the voltage required to achieve a stable reactance increases [14].

Sometimes it may be necessary to use a mixture of different solvents to achieve the most optimal formula of electrospin. In addition to the molecular weight and type of solvent of the polymer, the spin of the polymer solution is highly dependent on its concentration and electrical conductivity. A minimum concentration is required to achieve the disruption of the chain, which is very important for the transition from electrospraying to electrospinning to obtain fibers [15]. Interactions between polymer chains at concentrations below this limit are too weak to overcome Rayleigh instability. If the concentration is too high, the viscoelastic force will be very difficult to overcome and no reactive will be formed. Reducing the concentration at the appropriate interval helps to form thinner fibers. However, the polymer concentration also affects the viscosity and surface tension of the solution, and both parameters can affect the morphology and size of the fibers formed. In general, reducing viscosity and surface tension prefers the production of thin fibers, but this can also be achieved by adding a surfactant instead of reducing the polymer concentration [13,16]. If the viscosity is too low, fiber will not be produced. If the viscosity is too high, it will be difficult to remove the solution from the spinneret. As for the electrical conductivity, it is difficult to electrospin a perfectly insulating solution because such a solution cannot transfer a charge from the inside of the solution to its surface. If the solution is highly permeable, it will be difficult to form a Taylor cone as a result of electrostatic repulsion or to initiate elastic instability because surface charges cannot accumulate in the conductive droplet or jet [17,18]. So far, only a limited number of conductive polymers have been successfully electrospunged into nanoparticles by altering the polymer solutions and the state of the electrospin. PPy nanoparticles with an average diameter of 70 nm were produced during electric spinning. For example, PANi nano fibers with an average diameter of 139 nm were treated with an electrospun from a 20% PANi solution in 98% formic acid. Mixing a functional polymer with another electrospinnable polymer is an effective way to obtain a suitable solution of electrospin. For this purpose, the synthetic polymer can serve as a carrier phase, which greatly contributes to the process of electrospinning for the preparation of nanoparticles containing natural biopolymers. Nano fibers made from a polymer blend can also lead to new applications due to the combination of functions derived from individual components. It should be noted that different polymer components can be separated into separate phases of the reagent as a result of evaporation of the solvent. Separation can be softened by improving the compatibility between polymers and thereby confusing their chains [19].

CONCLUSION.

Thus, the formation of nanoparticle materials using the electrospinning method can be the basis for the development of nanotechnology for the production of new types of special properties filters. To this end, it is desirable to conduct scientific and technological research on innovative partnerships based on local polymers, and there is currently a need for such materials. Currently, many laboratories and technological devices for the formation of nanoparticles from polymer solutions and liquids are being developed. The uniqueness of nano-fiber production is that it is important to protect and improve the environment as it is used in many fields of healthcare and others. Nano fibers are part of a good material system that improves the electrical, optical, thermal, and mechanical properties of a large number of cast materials. Several electrospinning techniques have been developed to increase the efficiency of nano-fiber production. Some of these techniques include solution blowing (or air jet spinning), drawing technique, template synthesis, centrifugal spinning, phase reversal, separation and freezing, and drying synthesis.

REFERENCES:

1. Vollrath F; Knight DP Liquid Crystalline Spinning of Spider Silk. Nature 2001, 410, 541–548.
2. Heim M; Keerl D; Scheibel T Spider Silk: From Soluble Protein to Extraordinary Fiber. Angew. Chem., Int. Ed 2009, 48, 3584–3596.
3. Andersson M; Jia Q; Abella A; Lee X-Y; Landreh M; Purhonen P; Hebert H; Tenje M; Robinson CV; Meng Q; et al. Biomimetic Spinning of Artificial Spider Silk from a Chimeric Minispidroin. Nat. Chem. Biol 2017, 13, 262–264.
4. Physics of polymer fibers Mamadalimov AT, Rashidova S.SH. , Kholmominov A.A. , 2009)
5. A. Greiner, J.H. Wendorff. Functional Self-Assembled Nanofibers by Electrospinning. Adv. Polym. Sci. (2008) 219: 107–171.
6. Kholmuminov, A. A., Matyakubov, B. M., & Rakhmonov, T. T. Mechanical properties of elektrospunsilk fibroin nanofiber materials. (2020). InterConf.
7. Zenis Y Spinning Continuous Fibers for Nanotechnology. Science 2004, 304, 1917–1919.
8. Gilbert W De Magnete; Courier: New York, 1958.
9. Li D; Xia Y Electrospinning of Nanofibers: Reinventing the Wheel? Adv. Mater 2004, 16, 1151–1170.
10. Xue J; Xie J; Liu W; Xia Y Electrospun Nanofibers: New Concepts, Materials, and Applications. Acc. Chem. Res 2017, 50, 1976–1987.
11. Sun B; Long YZ; Zhang HD; Li MM; Duvail JL; Jiang XY; Yin HL Advances in Three-Dimensional Nanofibrous Macrostructures via Electrospinning. *Prog. Polym. Sci* 2014, 39, 862–890.
12. Liao Y; Loh CH; Tian M; Wang R; Fane AG Progress in Electrospun Polymeric Nanofibrous Membranes for Water Treatment: Fabrication, Modification and Applications. *Prog. Polym. Sci* 2018, 77, 69–94.
13. Hu J; Wang X; Ding B; Lin J; Yu J; Sun G One-Step Electro-Spinning/Netting Technique for Controllably Preparing Polyurethane Nano-Fiber/Net. *Macromol. Rapid Commun* 2011, 32, 1729–1734.
14. Luo CJ; Stride E; Edirisinghe M Mapping the Influence of Solubility and Dielectric Constant on Electrospinning Polycaprolactone Solutions. *Macromolecules* 2012, 45, 4669–4680.
15. Husain O; Lau W; Edirisinghe M; Parhizkar M Investigating the Particle to Fibre Transition Threshold During Electrohydrodynamic Atomization of a Polymer Solution. *Mater. Sci. Eng., C* 2016, 65, 240–250.
16. Talwar S; Krishnan AS; Hinestroza JP; Pourdeyhimi B; Khan SA Electrospun Nanofibers with Associative Polymer− Surfactant Systems. *Macromolecules* 2010, 43, 7650–7656.
17. Angammana CJ; Jayaram SH A Modified Electrospinning Method for Conductive and Insulating Materials. *Proc. ESA Annu. Meet. Electrost* 2010, L3.
18. Haider A; Haider S; Kang I-K A Comprehensive Review Summarizing the Effect of Electrospinning Parameters and Potential Applications of Nanofibers in Biomedical and Biotechnology. *Arabian J. Chem* 2018, 11, 1165–1188.
19. MacDiarmid A; Jones W; Norris I; Gao J; Johnson A; Pinto N; Hone J; Han B; Ko F; Okuzaki H; Llaguno M Electrostatically-Generated Nanofibers of Electronic Polymers. *Synth. Met* 2001, 119, 27–30.