MAAREF UNIVERSITY RESEARCH JOURNAL RJMU

Research Journal of Maaref University of Applied Sciences (RJMU)

Conference Paper

Vol 2, Issue 1, pages.110-113, February (2026) **ISSN:** 3105-7985

Recycling Polysulfone by Electrospinning and Testing Its Nanofibers in Water Desalination

Wafaa Yakhne [1] * Jamal Kassem Alshar [2] M. A. Batal [3]

[1] Dept. of Physics, Faculty of Science, University of. Aleppo, Syria

[2] Dept. of Physics, Faculty of Science, University of. Aleppo, Syria

[3] Dept. of Physics, Itihad Private University, Syria

*Corresponding Author: e-mail: wafaayakhneph1992@gmail.com

Available online at: https://journal.mas.edu.sy/MASV02E01D02202621

Received: 10 December 2025 Revised: 27 December 2025 Accepted: 07 January 2026

***Abstract*—** A polysulfone filter used in a kidney dialysis machine was used. The polysulfone fibers were mechanically, chemically, and thermally treated. Then mixed with an appropriate concentration of PVP. The as mixed dissolved in DMF, taking into account the appropriate viscosity. The solution was electrospinning. The distance between the collector and the spinning needle tip was kept to 15cm, and the applied voltage was 24Kv. The structural and optical properties of the spun mat were studied, and the nanostructure of the mat was confirmed. The mat's effectiveness in absorbing NaCl ions was tested, and it was found that a 0.057mm thick mat removed 22% of the salinity, confirming its potential as a seawater desalination filter when used with other polymers such as polyamides.

***Keywords*—** Electrospinning, Polysulfone, Polymer, Filter, PVP, Desalination.

I. INTRODUCTION

Practicality in producing nanostructures characterized by their smooth surface and high surface area-to-volume ratio. This technique involves applying a high voltage to a polymer solution or molten metal. To form a Taylor cone, it is drawn to form nanofibers and deposited on the collector. It has been widely applied in controlling nanofiber structures, solar cells, fuel cells, and energy storage. Figure 1 shows a diagram of an electrospinning device, which includes a high-voltage generator, injector, and collector.[1]

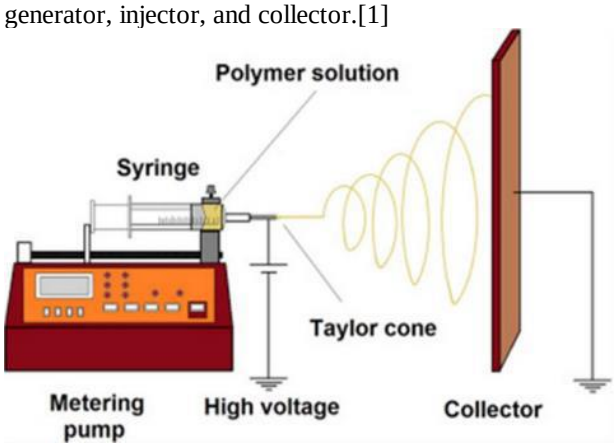


Figure (1): Diagram of the electro-spinning device

II. Applicationsof nanomaterials in water treatment :

Nanomaterials are a revolutionary solution in water treatment due to their unique properties, such as high surface area, enhanced chemical activity, and the ability to efficiently remove pollutants.

These materials are used in filtration, photocatalytic, absorption, and disinfection systems. Let's review the most prominent applications.[2]

Multi-layer filtration systems

Graphene oxide (GO) membranes

The efficiency of salt removal depends on the spacing of the layers (d). (interlayer spacing).[3].

III. The importance and objectives of the research:

-Recycling medical-grade polysulfones for reuse involves electrospinning to enhance the material's catalytic properties

- Using recycled polysulfones as filters for water desalination

IV. Method of preparing and spinning nanofibers

- The used polysulfone fibers were collected, washed with dilute hydrochloric acid, dried, and then ground.
- 0.3 g of polysulfone was dissolved in 3 ml of DMF solution and stirred in a magnetic mixer at 60°C for 2 hours. After dissolving, 0.2 g of polyvinylpyrrolidone (PVP) was added and mixed for 4 hours to homogenize the solution.
- The homogenized solution was placed in a syringe and attached to a spinning machine after setting the parameters. A voltage of 24 kV was applied, the distance between the syringe needle and the collector was 15 cm, and the flow rate was set to 1 ml/hour.[4].[5]

V. Measurements and discussion:

Surface structure (morphology):

The aim of determining the surface structure of spun fibers made from (PSU/PVP). The Atomic Force Microscopy AFM system was used. The Figure shows an AFM image, which indicates that the surface structure of the spun fibers has an average diameter of 945 nanometers. With a surface roughness of 179.15 µm. As shown in Figure 2 [6].

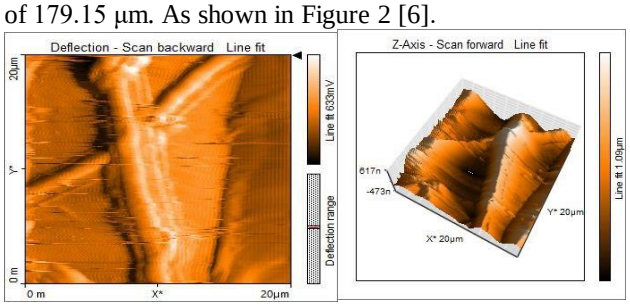


Figure (2): Shows an AFM image of spun (PS/PVP) fibers

Crystal structure:

It is observed from the figures that the *XRD spectrum* obtained gives the same intensities of the XRD diffraction peaks at *2Θ as* in the reference spectrum. As shown in Figure (3) and As shown in Figure (4) [7]

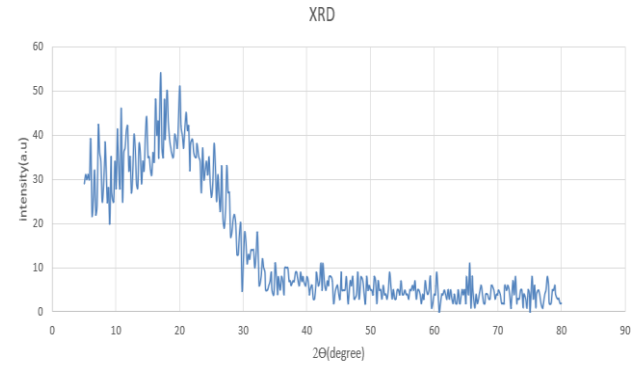


Figure (3) XRD spectrum of spun polysylene fibers

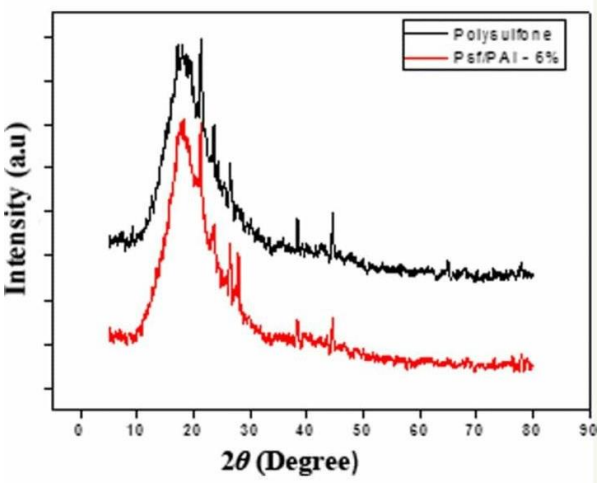


Figure (4) Reference XRD Spectrum of Polysulfone

UV-VIS Absorption Spectrum:

The absorption spectrum of (PSU /PVP) nanofibers was taken before heat treatment using a Spectro photo meter (UV-VIS), within the wavelength range (200-1100) nm

The optical absorption spectrum of the nanofibers was measured in the (200–1100) nm range using a UV-Vis spectrometer. The spectrum showed two main peaks at 295 nm (attributable to the π → π* transition in the aromatic polysulfone rings) and an absorption region at 580 nm, which may be related to light scattering from the fibrous nanostructure. As shown in Figure 5 [8]

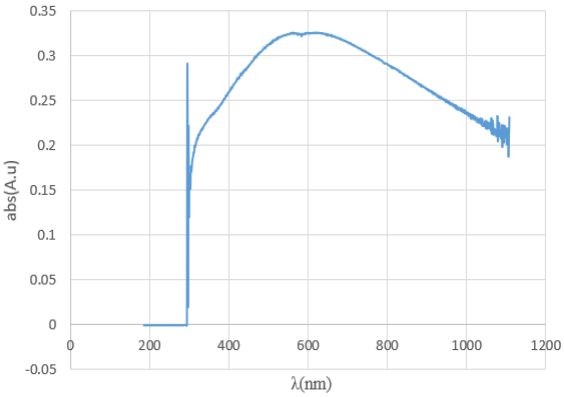


Figure (5) UV absorption spectrum

***FTIR Spectrum*:**

spun (PSU/PVP) fibers, an FTIR spectrum was taken, and Figure 6 shows the *IR spectrum* within the wavenumber range of (4000-400) cm^{-1}. Structural Interpretation Based on the Spectrum

The provided FTIR spectrum shows excellent agreement with the expected chemical structure of polysulfide.

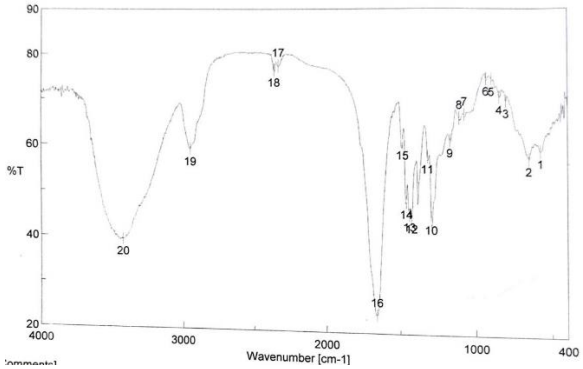
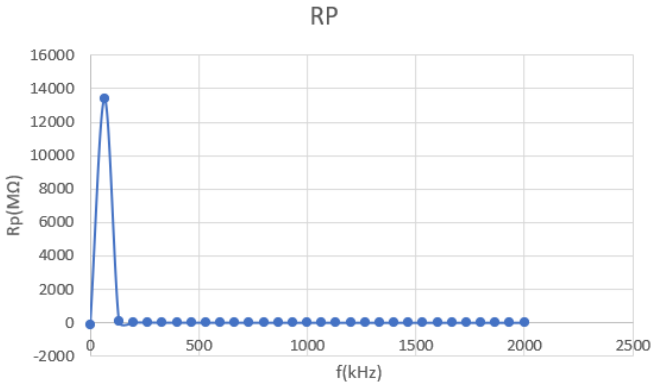


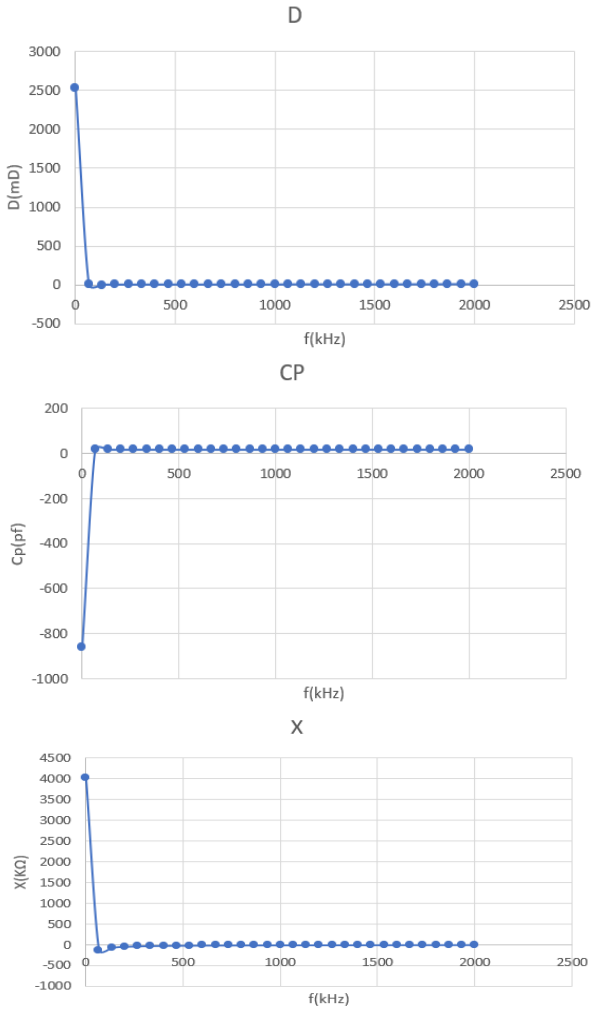
Figure (6) FTIR spectrum of spun polysylene fibers

Alternating Current Measurements:

Electrical measurements were taken using an *LCR meter*; the resistance of the spun mats was found to be high, reaching on the order of M *Ω,* confirming their electrical insulating properties. The figure shows that the values were high at low frequencies *(20Hz-200kHz)* and then stabilized in the range *(*200-2000kHz) As shown in Figure 7.



© 2026, RJMU All Rights Reserved



Figures (7) LCR measurements of spun fibers

Electrical measurements showed that the spun mat is an insulator of electrical current.

Membrane efficiency test for water desalination:
100 ml of distilled water was taken, and 3.2 g of NaCl (the salinity of seawater) was added. The water's conductivity was measured before filtration, and it was found that a 0.057 mm thick membrane reduced the conductivity to 22% of the original value, as shown in Table 1.

Table 1 shows the electrical conductivity values of the water before and after filtration.

Water conductivity value (µS/cm)	Number of filters
47.3	Before filtering
39.4	After the first time
43.9	After the second time

The membrane was washed with distilled water several times, and then the experiment was repeated. It was found that the percentage of decrease in water conductivity was 47.5ms, and after filtration, it was 38.9ms. The decrease in conductivity is evidence of the efficiency of the membrane used in removing water salinity.[9]

VI. Conclusions

1- The polysilicon used in the kidney dialysis machine was successfully recycled through mechanical, chemical, and thermal treatment.[10]
2- Polysylene fibers were spun with a PVP ratio to give them a suitable viscosity and allow them to harden quickly.
3- Polysylene fibers were spun with a PVP ratio to give them a suitable viscosity and allow them to harden quickly.
4- The crystal structure showed that it was identical to reference (7), which confirms that electrospinning did not damage the polysilicon structure. This is also confirmed by an instantaneous conversion of the infrared spectrum.
5- Electrical measurements showed that the spun mat is an insulator of electrical current.
6- Practical experiments showed that the efficiency of removing salinity from water exceeded 20% for a membrane with a thickness of 0.057mm, with repeated filtration.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest.

Funding

The authors received no financial support for this book review.

Human Participants

This paper does not involve human participants.

Originality Note

The authors confirm that the manuscript is their original work, and if others' works are used, they are properly cited/quoted.

VII. REFERENCES

1. Alessandro DiMauro, Massimo Zimbone ,andatel, 2016, Synthesis of ZnOnanofibers by the electrospinning process, Materials Science in Semicondoctor Processing, vol.42,98.
2. Qu, X., Alvarez, P. J., & Li, Q. (2013). Applications of nanotechnology in water and wastewater treatment.
3. Joshi, R. K., et al. (2014). Precise and ultrafast molecular sieving through graphene oxide membranes.
4. Khalil, A., et al. (2017). Fabrication of polysulfone/polyvinylpyrrolidone nanofibrous membranes for water filtration. Journal of Applied Polymer Science, 134(25), 44961.
5. Wang, X., et al. (2012). Electrospun nanofibrous membranes for high flux microfiltration. Journal of Materials Chemistry, 22(5), 1445–1449.
6. Huang, Z. M., et al. (2003). A review on polymer nanofibers by electrospinning and their applications in nanocomposites. Composites Science and Technology, 63(15), 2223–2253.
7. Preparation and characterization of polysulfone/graphene oxide nanocomposite membranes for CO_2 separation.2017. Chemical Engineering Journal.
8. M. S. A. Abdel-Mottaleb, A. A. M. Ali, Effect of PVP concentration on the optical and morphological properties of polysulfone-based nanofibers.
9. R. J. Petersen, J. E. Cadotte.2016, Laboratory-scale evaluation of polysulfone ultrafiltration membranes for seawater pretreatment, Desalination and Water Treatment.
10. Tan Yong Chee, Abdull Rahim Mohd Yusoff , Faizaan Abdullah.,2021. Fabrication, characterization and application of electro spun polysulfone membrane for phosphate ion removal in real samples, University Tektology Malaysia, 81310, Johor Bahru, Johor, Malaysia, Version of Record 13 June 2022.

© 2026, RJMU All Rights Reserved

About the authors

Wafaa Yakhni is a physicist and university lecturer based in Aleppo, born July 2, 1992. She earned a Bachelor's degree in Physics from the University of Aleppo (2017), followed by a Master's degree in Electronics Physics (2021), and a PhD in Electronics Physics (Plasma) (2024) from the University of Aleppo. She speaks Arabic and English. She has been a lecturer at the University of Aleppo since 2019 and is currently also teaching at Al-Rawad University for Science and Technology, delivering a range of physics courses, including electronics, digital electronics, and foundational physics for engineering students. Her research record includes two published papers in the University of Aleppo Research Journal, with two additional papers under review in nanotechnology and nuclear radiation detection. She participated in the Al-Maaref University scientific conference (2024) and completed 18 months of training in gamma camera operation, imaging techniques, and radioactive material injection protocols.

Jamal Qassem Al-Shar is a Professor in the Physics Department, Faculty of Science, University of Aleppo. He earned his Bachelor's degree in Physical Sciences from the University of Aleppo, then pursued advanced studies in the former Soviet Union, obtaining a PhD from Minsk State University. He speaks Arabic and Russian. His academic work includes teaching physics courses at the University of Aleppo, conducting research on alloys and their electrical and physical properties, and contributing to studies on nanotechnology-prepared materials and their applications. He has participated in several scientific conferences and seminars at Syrian universities, authored multiple specialized scientific books—including works on digital electronics and the history of physics—and supervised many Master's and PhD students across universities. He has also taught physics courses for engineering students at several private universities.

M. A. Batal is a Professor of Physics, born March 11, 1949, of Syrian Arab descent, and fluent in Arabic, English, and French. His academic training includes a Bachelor's degree in Physical and Chemical Sciences (Aleppo), an Advanced Studies Diploma from the University of Lyon (France), a PhD (Third Cycle) in Atomic and Molecular Physics (Lyon 1, France), and a State Doctorate in Plasma Physics from the National Institute of Applied Sciences (INSA), Lyon (France). He has taught university-level physics courses since 1981 and completed research work in England (University of Hull) for six months on laser applications, including plasma-enhanced laser atomization. He is the author of several books—covering topics such as electronics, atomic and molecular spectroscopy, and quantum mechanics—and has led or contributed to research projects in nanotechnology, with more recent publications in materials science and nanomaterials. He has supervised numerous Master's and PhD theses at the Universities of Aleppo, Idlib, and Tartous, and participated in many conferences and seminars (2000–2024) in areas including nanotechnology and laser research. His international teaching experience includes appointments at the University of Mascara (Algeria, 1988–1990) and Qassim University (Saudi Arabia, 2000–2007).

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International (CC BY-NC 4.0) which allows reusers to distribute, remix, adapt, and build upon the material in any medium or format for noncommercial purposes only, and only so long as attribution is given to the creator.