

Reduced graphene oxide-based electrospun mats doped with green-synthesized silver nanoparticles: A biodegradable and antibacterial wound healing scaffold.

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Introduction

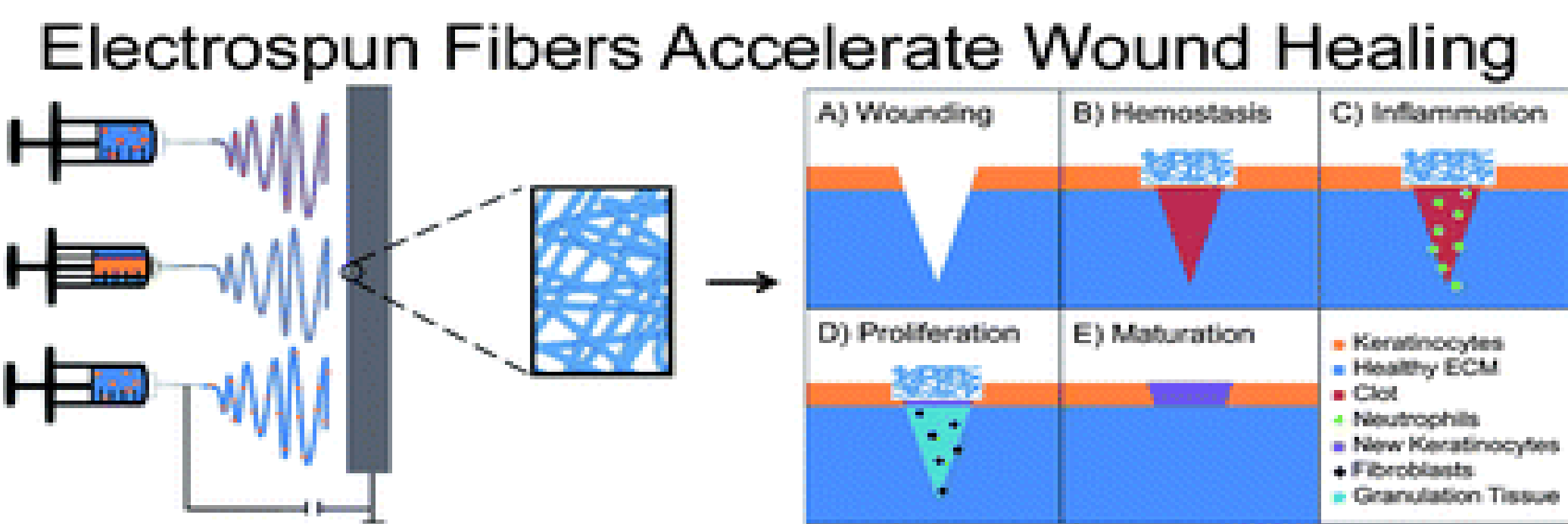


Figure 1: Electrospun Mats for wound healing applications
Source: <https://doi.org/10.1039/C3TB20795A>

- ❑ This research focuses on developing a novel electrospun composite using Polyvinyl Alcohol, Hydrolyzed collagen, and reduced graphene oxide, further modified with green-synthesized silver nanoparticles.
- ❑ Polyvinyl Alcohol (PVA): Biocompatible, Non-toxic
- ❑ Hydrolyzed Collagen(HC): Bioactive compound derived from Collagen
- ❑ Reduced Graphene Oxide (rGO): Antibacterial, Biocompatible and conductive

Methodology

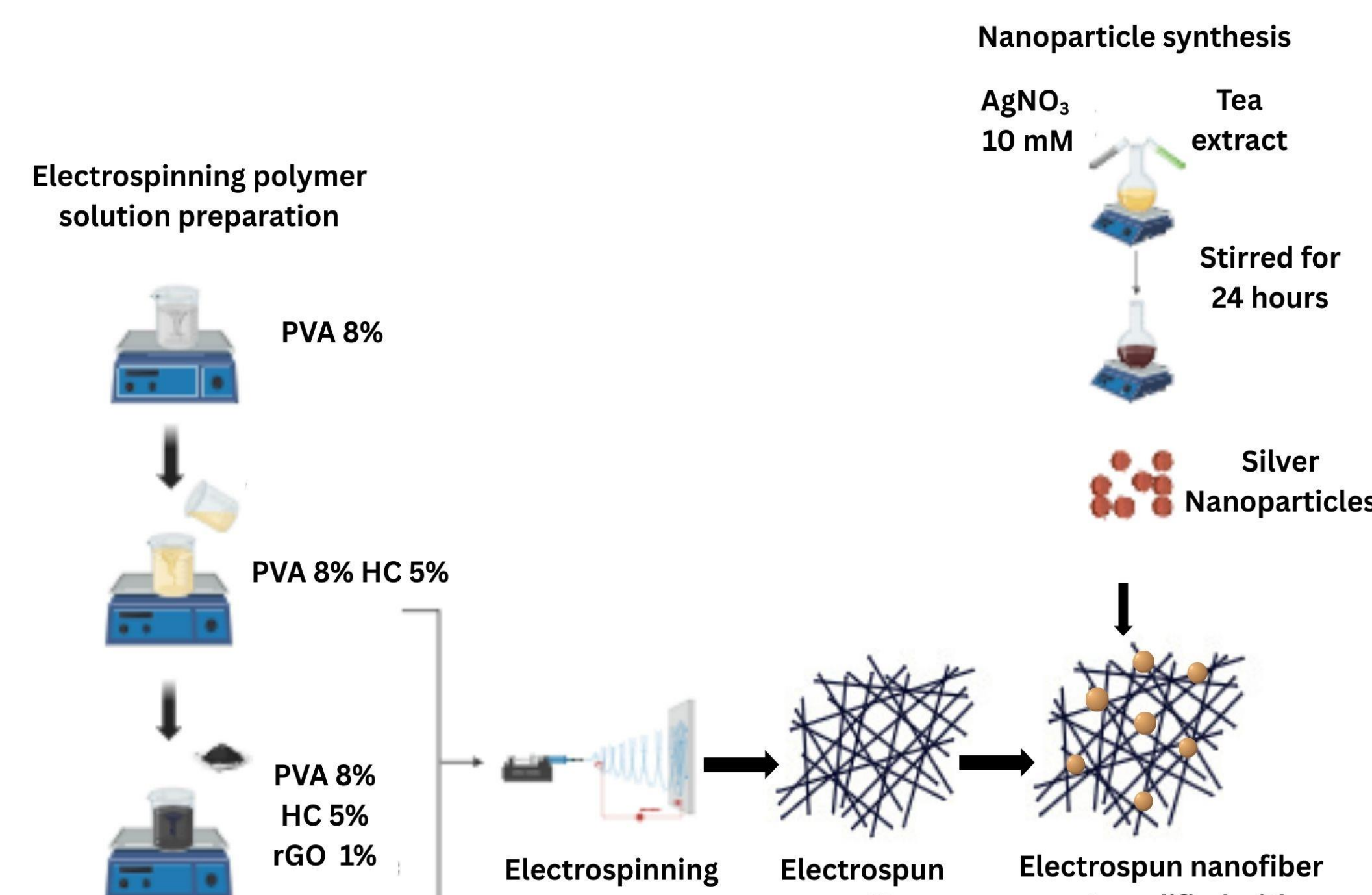


Figure 2 : Graphical illustration of the research methodology

Results and Discussion

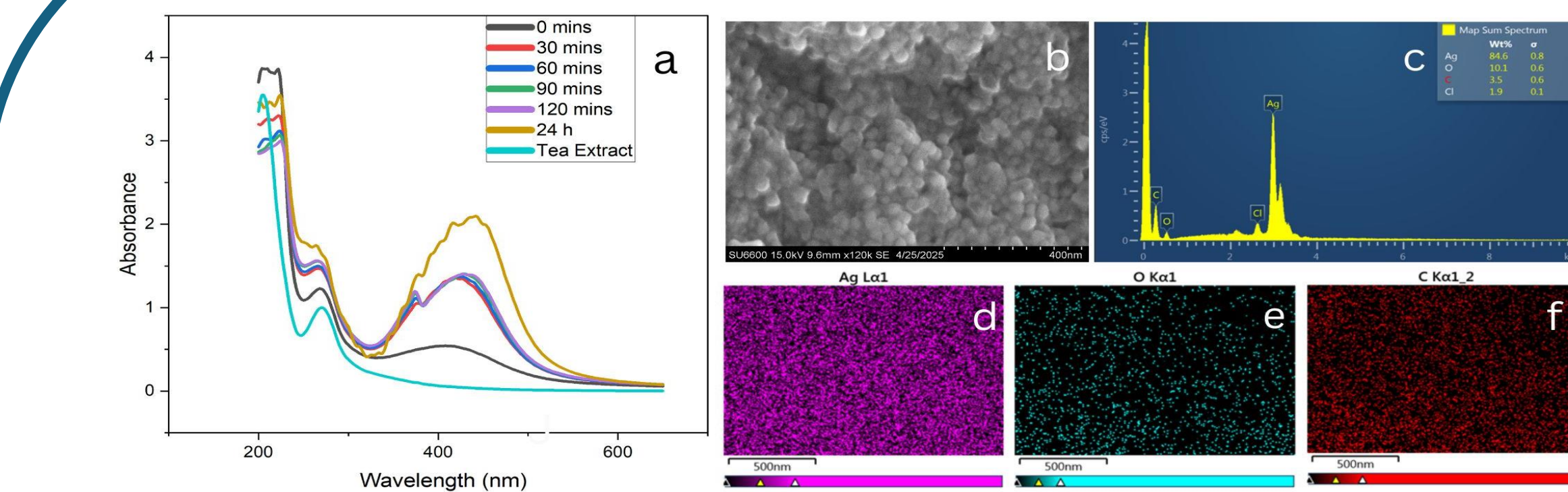


Figure 3: (a) UV-VIS spectrum of silver nanoparticles (Absorbance Vs Wavelength in nm) at different time intervals (b) SEM image of AgNPs (scale bar = 400 nm) (c) EDX spectrum of AgNPs (d) Elemental mapping of the constituent elements (d-f)

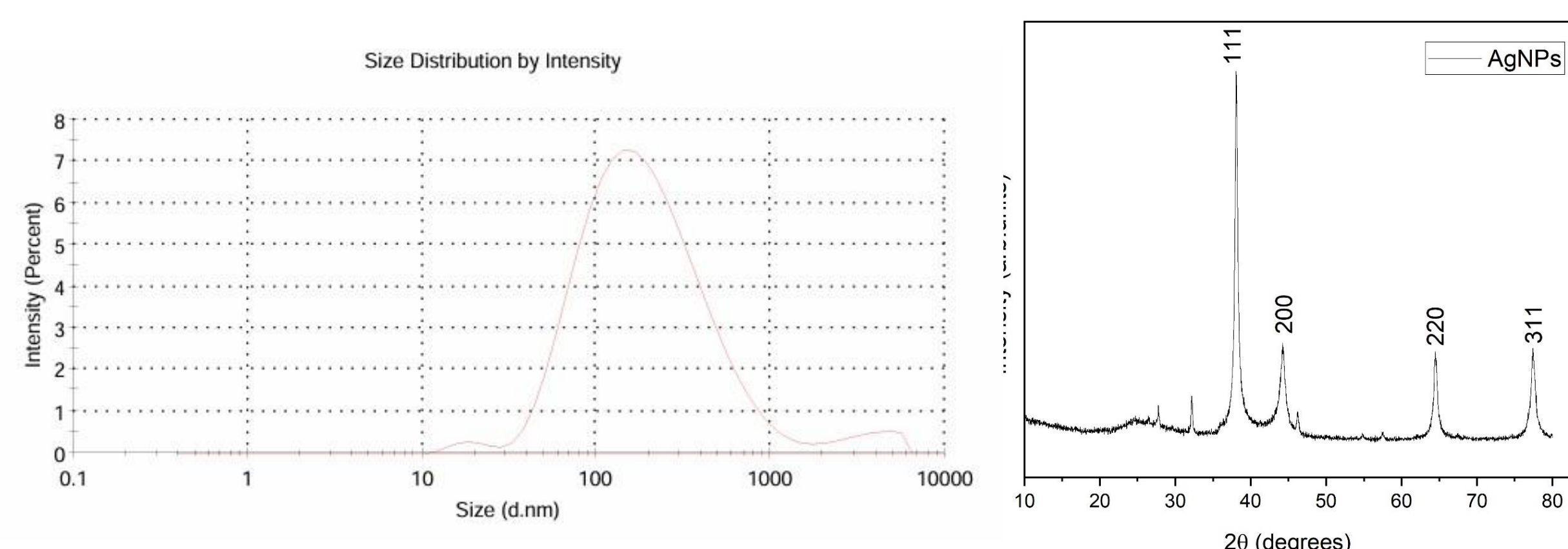


Figure 4 : The particle size distribution of AgNPs

Figure 5: The XRD pattern of AgNPs

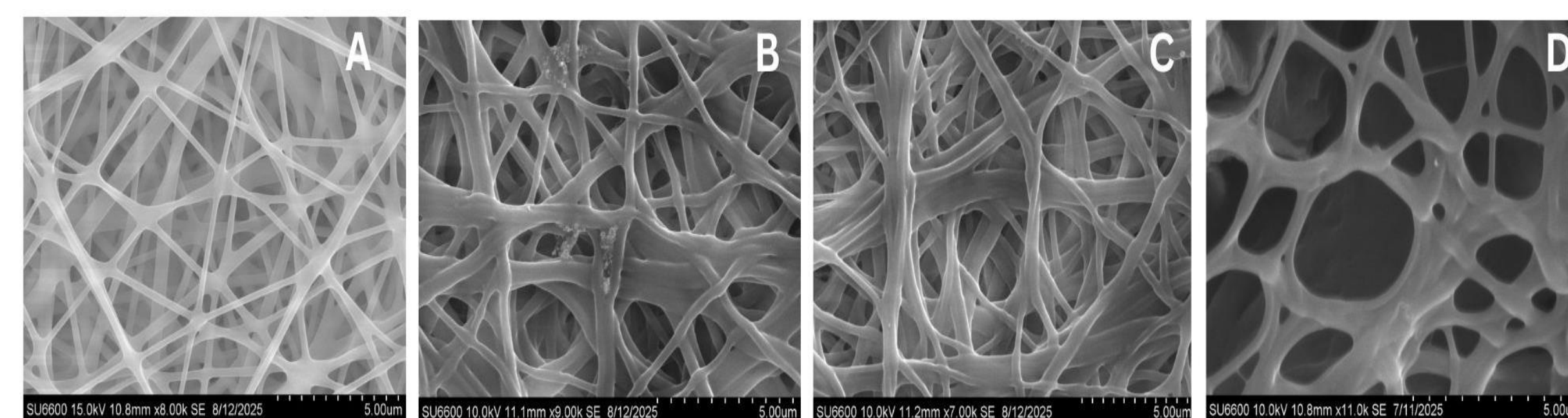


Figure 6: Morphology of (A) PVA/HC nanofiber mat before crosslinking, (B) PVA/HC/rGO nanofiber mat before crosslinking, (C) PVA/HC mat after crosslinking, (D) PVA/HC/rGO mat after crosslinking (Scale bar= 500 nm)

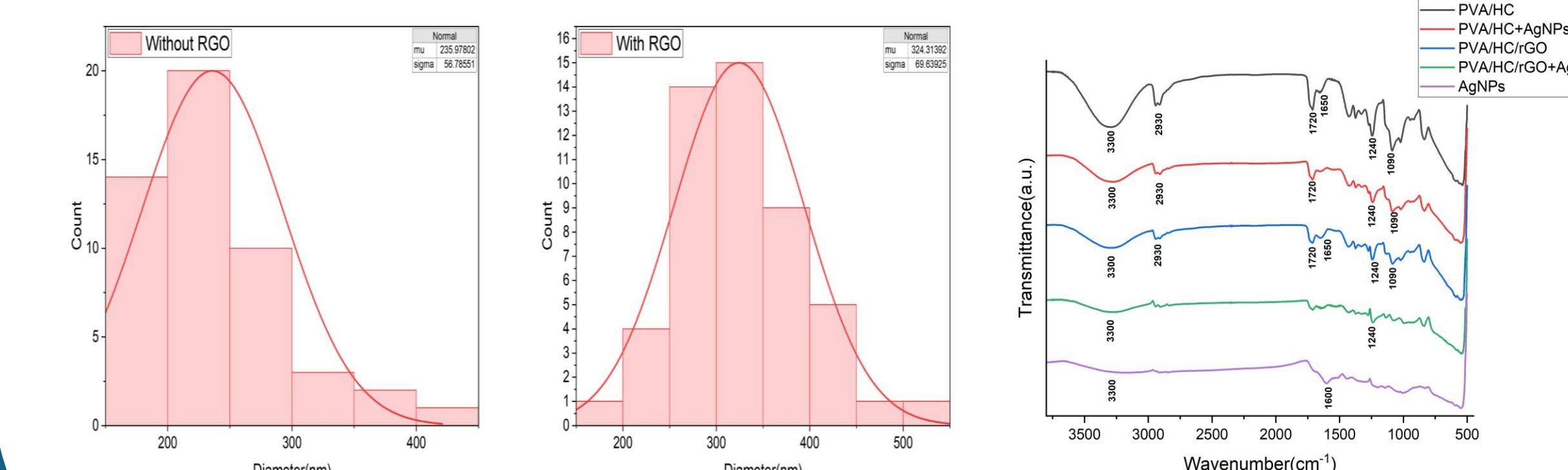


Figure 7 : The diameter distribution of nanofibers

Figure 8: FTIR spectrum of electrospun nanofiber mats and AgNPs

Results and Discussion

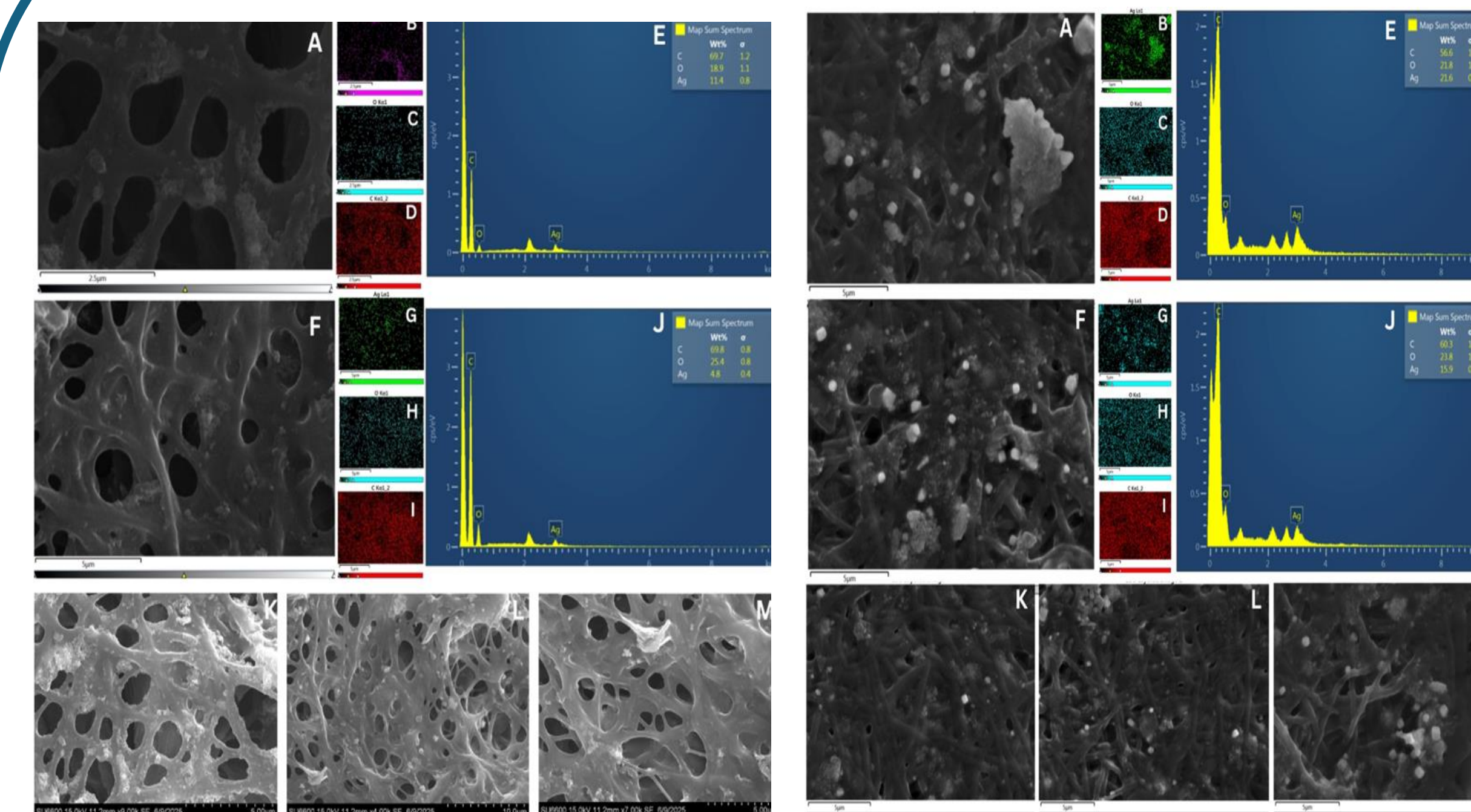


Figure 9: (A,F,K-M) SEM image of sample PVA/HC/rGO+AgNPs (Scale bar = 5µm) (B-D, G-I) Elemental mapping indicating the distribution of Ag, O, and C, respectively. (E,J) EDX spectrum of PVA/HC/rGO+AgNPs

Figure 10: (A,F,K-M) SEM image of sample PVA/HC+AgNPs (Scale bar = 5µm) (B-D, G-I) Elemental mapping indicating the distribution of Ag, O, and C, respectively. (E,J) EDX spectrum of PVA/HC+AgNPs

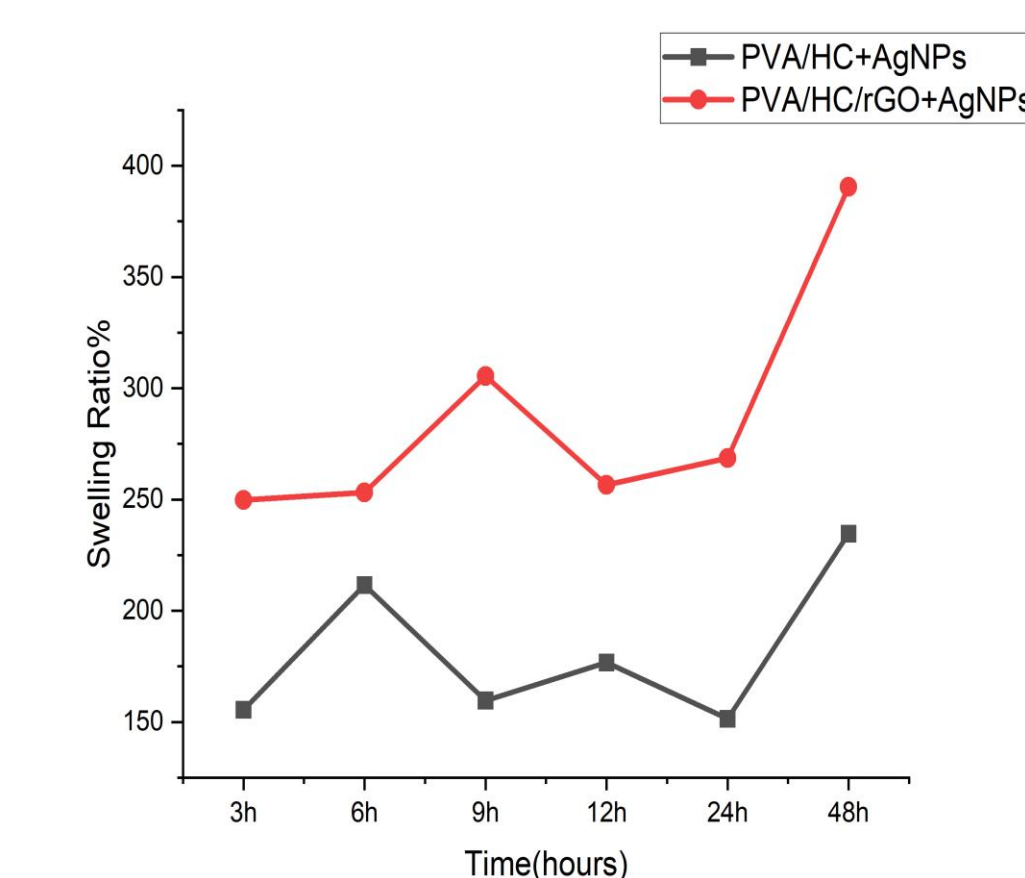


Figure 11: Swelling ratio of nanofiber mats

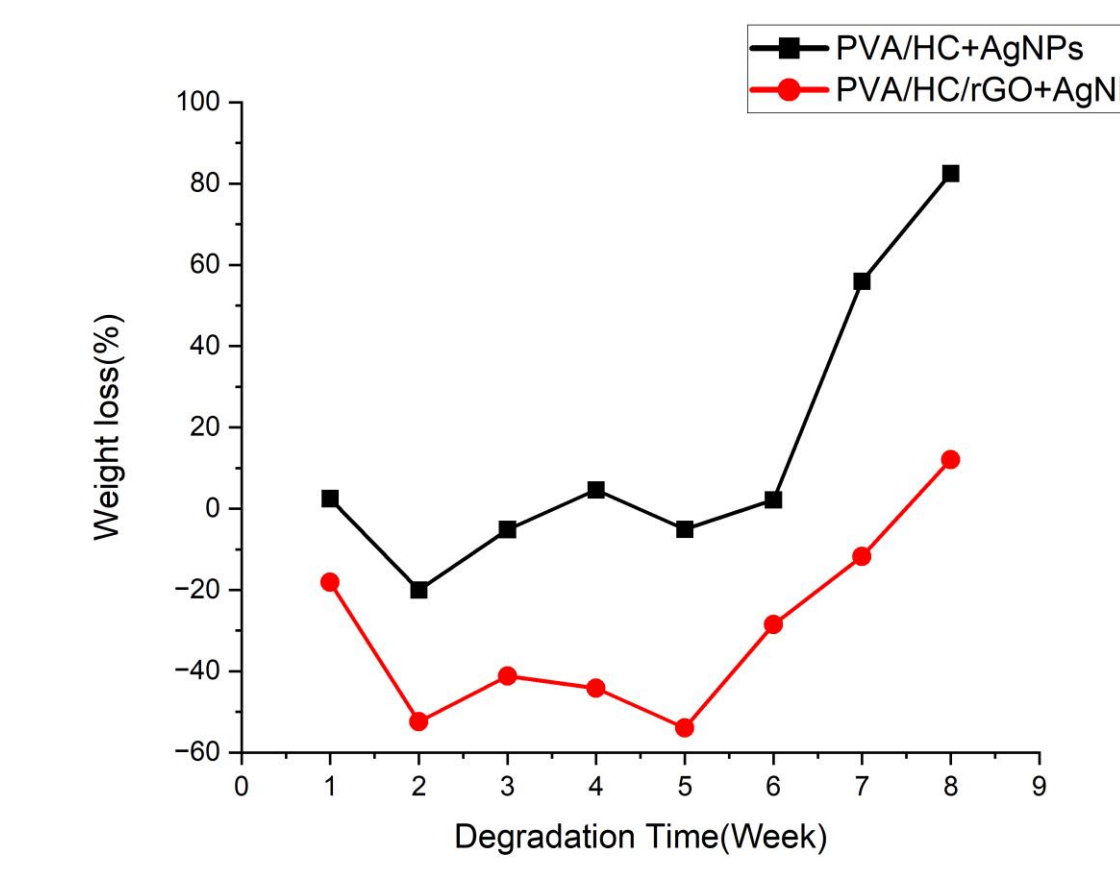


Figure 12: Degradation of nanofiber mats

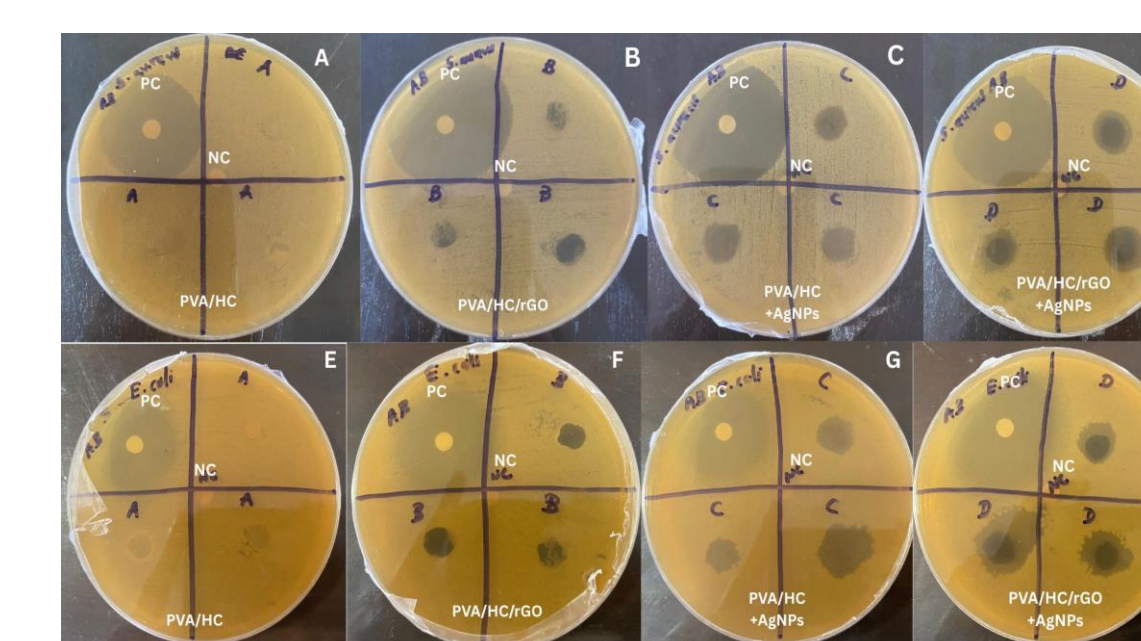


Figure 13 : The results of the antibacterial test

Sample type	Average diameter of the inhibition zone in mm	
	<i>E.coli</i>	<i>S.aureus</i>
Gentamicin	32.0 ±0.0	37.0 ±1.0
Tea Extract	07.5 ±0.7	07.7 ±0.6
PVA/HC/rGO+AgNPs	14.3 ±1.5	12.3 ±2.5
PVA/HC+AgNPs	12.0 ±1.0	09.0 ±1.0
PVA/HC/rGO	No Inhibitory Zone	No Inhibitory Zone
PVA/HC	No Inhibitory Zone	No inhibitory zone

Table 1: Average diameter of the zone of inhibition of the Antibacterial Assay

Conclusion

- ❑ Incorporation of rGO notably enhances the dispersion and stabilization of AgNPs, as observed in uniform elemental mapping and SEM images, thereby preventing nanoparticle aggregation and improving the electrospun fiber structure.
- ❑ The presence of rGO increases fiber diameter, swelling capacity and porosity of the nanofiber mats.
- ❑ Antibacterial assays confirm the superior antimicrobial activity of mats combining rGO and AgNPs against both Gram-positive and Gram-negative pathogens.
- ❑ The incorporation of rGO maintained the porosity of the scaffold even after crosslinking mimicking the extracellular matrix of the skin.

Future Work

- ❑ The future work will focus on studying the in-vitro biocompatibility and wound healing rate of the fabricated nanofiber mats.

Acknowledgement

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References

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