cbecimat26
26° Congresso Brasileiro de Engenharia e Ciência dos Materiais
22 a 26 de novembro de 2026
Costão do Santinho
Florianópolis-SC

Synthesis and characterization of PCL electrospun fibers with magnetite nanoparticles for biomedical applications

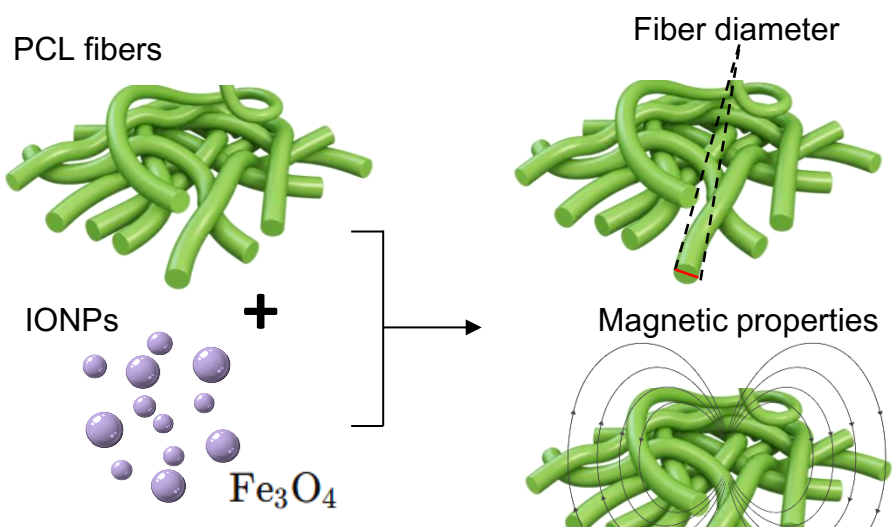
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Introduction

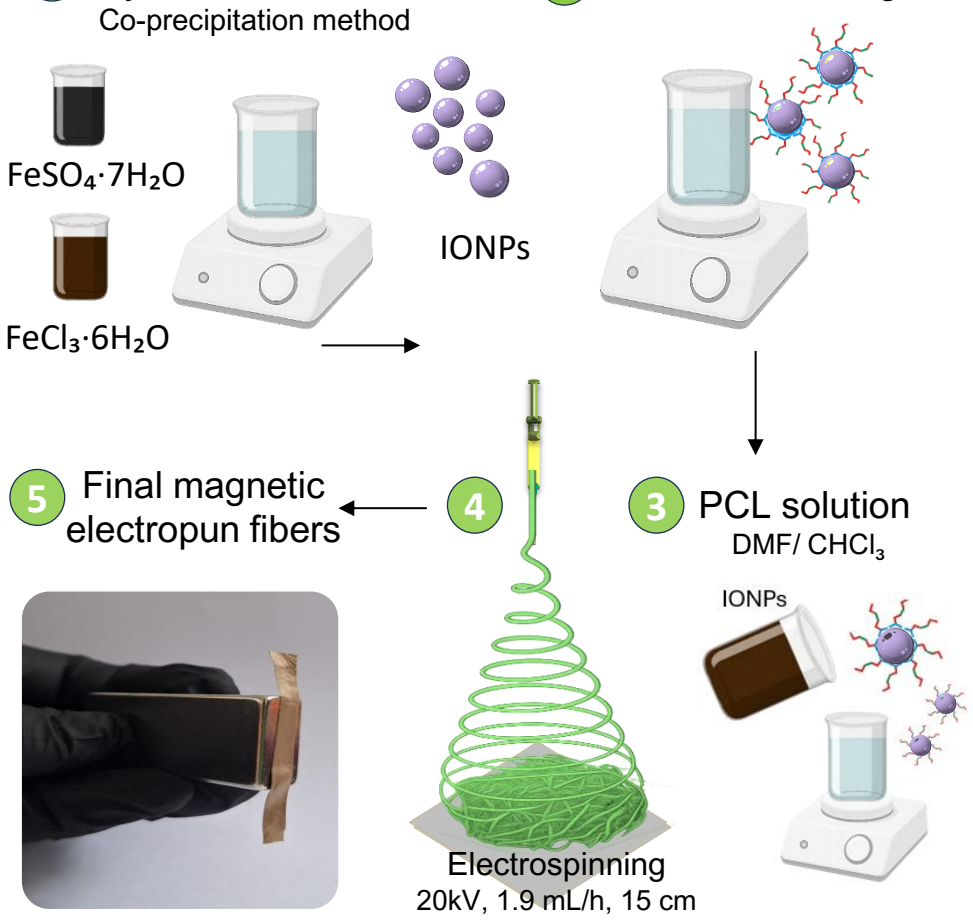
Magnetic electrospun fibers have been used in advanced biomedical applications, including cell guidance, magnetic hyperthermia, and drug delivery[1]. However, one of the main challenges is producing fibers with controlled morphology and suitable magnetic properties[2]. This work investigates the influence of polycaprolactone (PCL) electrospinning parameters and oleic acid-coated magnetite nanoparticles (IONPs/OA) on fiber morphology, crystallinity, wettability, and magnetic properties.



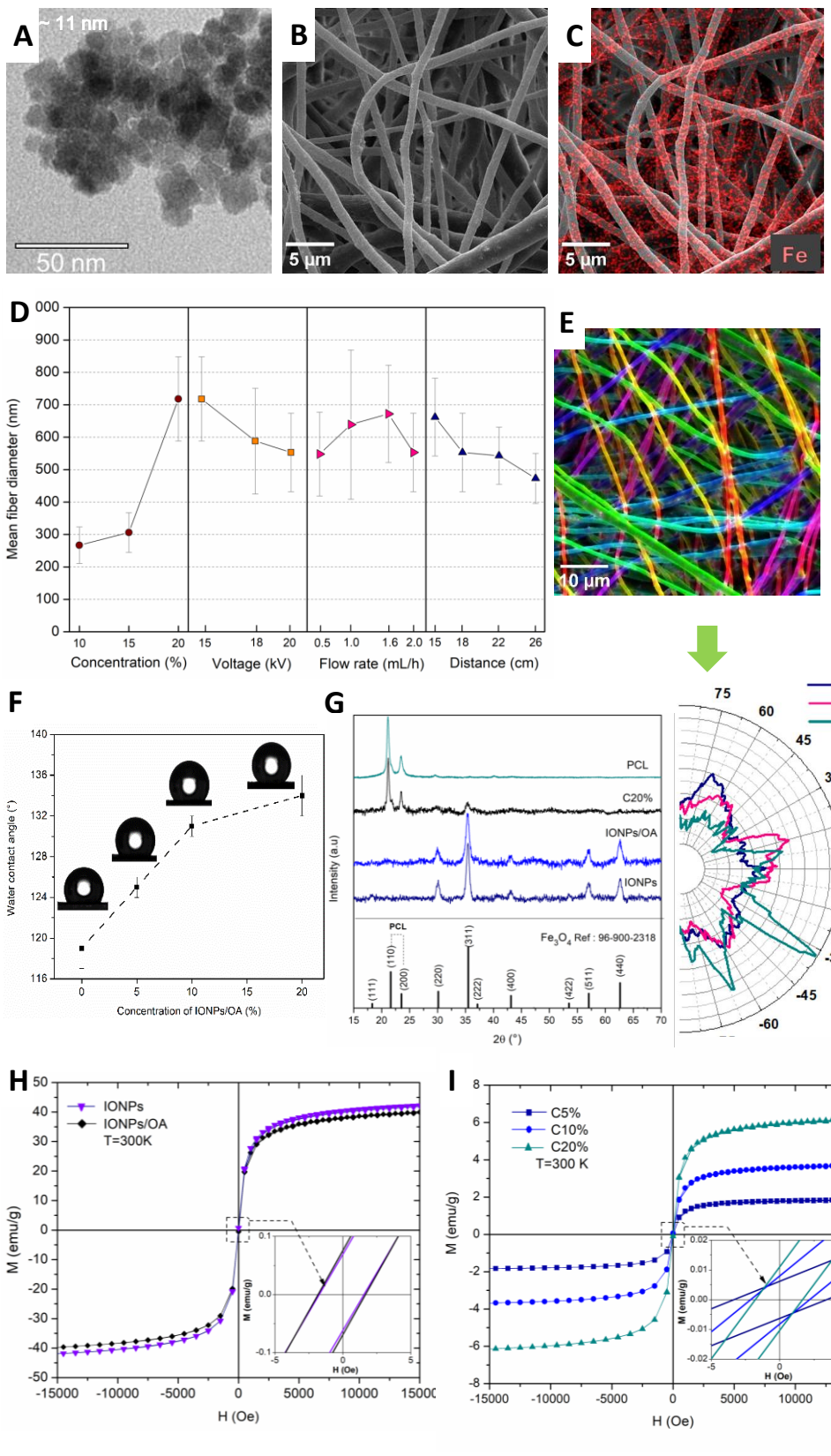
Objectives

- **Optimize** the PCL electrospinning parameters (applied voltage, flow rate, and needle-to-collector distance)
- **Promote** NP–polymer compatibility through surface modification IONPs with oleic acid (OA).
- **Characterize** the structural, compositional, magnetic, morphological, and wettability properties.

Methodology



Results and discussion



A) TEM micrograph of IONPs. **B)** SEM micrograph of PCL/IONPs fibers. **C)** EDS elemental mapping. **D)** Electrospinning processing parameters. **E)** Fiber orientation analysis. **F)** Wettability measurements. **G)** XRD analysis. **H)** and **I)** Magnetic properties of IONPs and PCL/IONPs fibers.

Conclusions

- Homogeneous PCL fibers were obtained with an average diameter of **543 ± 88 nm.**
- IONPs/OA incorporation increased fiber diameter to **961 ± 201 nm**.
- Fiber hydrophobicity increased, reaching a water contact angle of **135°.**
- The fibers exhibited superparamagnetic behavior, with a maximum saturation magnetization of **6.1 ± 0.1 emu/g.**
- These results demonstrate favorable fiber morphology and magnetic properties, suggesting their potential for future biomedical applications.

References and Acknowledgments

[1] HLUKHANIUK, A. et al. ACS Biomater. Sci. Eng., 11, 2025.
[2] VATS, N. et al. Scientific Reports, 15, 23314, 2025.

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