

# **ANTIMICROBIAL NANOSTRUCTURED MATERIALS FOR BIOMEDICAL APPLICATIONS**

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## **Abstract**

This doctoral thesis addresses the need for innovative materials in the biomedical field aimed at reducing infections caused by multidrug-resistant microorganisms while simultaneously promoting sustainable solutions for plastic waste management. In this context, the research explores the potential of recycled polyethylene terephthalate (rPET) as a raw material for the fabrication of nanostructured fibers using electrospinning technology, with potential applications in biomedical devices and wound dressings.

The thesis includes three experimental studies focused on the development and characterization of rPET-based electrospun membranes functionalized with antimicrobial agents. The first study investigated rPET membranes loaded with zinc oxide nanoparticles, demonstrating strong antimicrobial activity against Gram-positive and Gram-negative bacteria as well as fungal strains. The materials showed no cytotoxic effects on amniotic fluid stem cells and did not induce adverse reactions in *in vivo* animal models. The second study focused on the fabrication of rPET nanofibers functionalized with alginate and copper, which exhibited significant antimicrobial activity, effective inhibition of biofilm formation, and high cellular biocompatibility. The third study involved the development of electrospun rPET scaffolds coated with chitosan, which showed antibacterial activity and favorable tissue integration following *in vivo* implantation.

Overall, the obtained results highlight the versatility and potential of electrospun rPET materials as promising platforms for antimicrobial wound dressings and other biomedical applications. The study also emphasizes the importance of optimizing electrospinning parameters and integrating bioactive compounds to develop safe, effective, and sustainable materials for infection prevention and advanced wound management.