Bio-graphene nanocomposite polymeric membranes for the mitigation of biofouling

Christina Alatzoglou[1], Michaela Patila[1], Maria G. Trachioti[2], Mamas I. Prodromidis[2], Haralambos Stamatis[1*]

[1] Biotechnology Laboratory, Department of Biological Applications and Technologies, University of Ioannina, 45110 Ioannina, Greece

[2] Laboratory of Analytical Chemistry, University of Ioannina, 45110 Ioannina, Greece

*Corresponding author: E-mail: hstamati@uoi.gr, Tel +30 26510 07116

INTRODUCTION

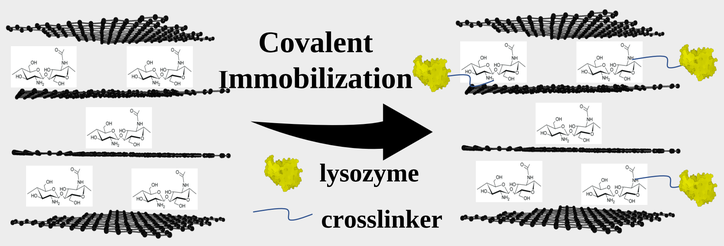
- Biofouling is defined as the accumulation of microorganisms and is a significant barrier to the proper function of wastewater ultrafiltration membranes.
- The development of nanocomposite polymeric membranes using different enzymes could provide a sustainable operation for water purification and an effective way for the degradation of biofouling.
- The green exfoliation of graphite to pristine graphene using biological agents, such as chitosan provides biographene (BG) with functional groups that make the material suitable support for enzyme immobilization.
- Incorporation of nanobiocatalysts with antimicrobial activity on the membrane surface can mitigate biofouling and improve the properties of the membranes.

OBJECTIVE

In this work, polyethersulfone (PES) membranes were modified by combining nanomaterials and enzymes with antimicrobial activity.

METHODS

1)Synthesis of the nanobiocatalyst



bio-Graphene with chitosan (bG+chit)

Nanobiocatalyst

2)Synthesis of the membrane

Casting solution:
PES 18%w/w
Dmac 79,6% w/w
Acetone 0,4% w/w
PVP 2% w/w
Nanobiocatalyst

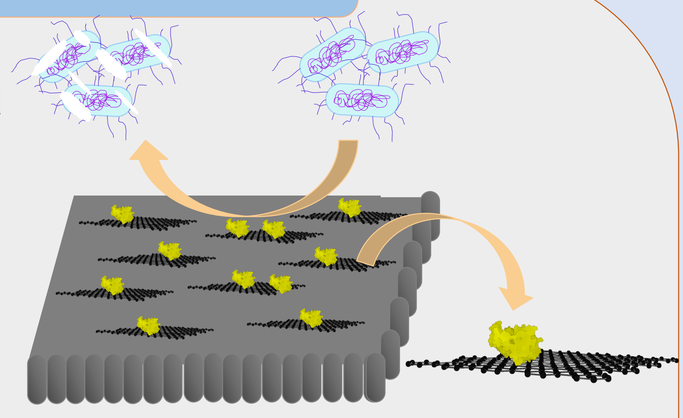
Phase Inversion

Coagulation bath

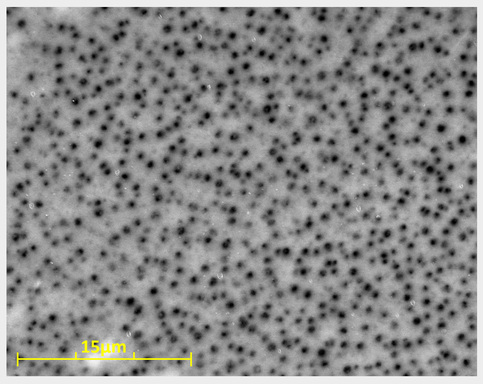
24h

Nanocomposite Polymeric Membrane

3) Testing of antimicrobial activity



RESULTS



SEM image presents the pores on the surface of the membrane. The mean pore size is ~110nm.

Figure 1. SEM image of PES membrane

Table 1. Catalytic activity of free and immobilized lysozyme

Sample	Immobilization yield (%)	Activity (Units)
Free lysozyme	-	48.0 ± 0.8
Immobilized lysozyme	46.3 ± 2.6	24.5 ± 1.1

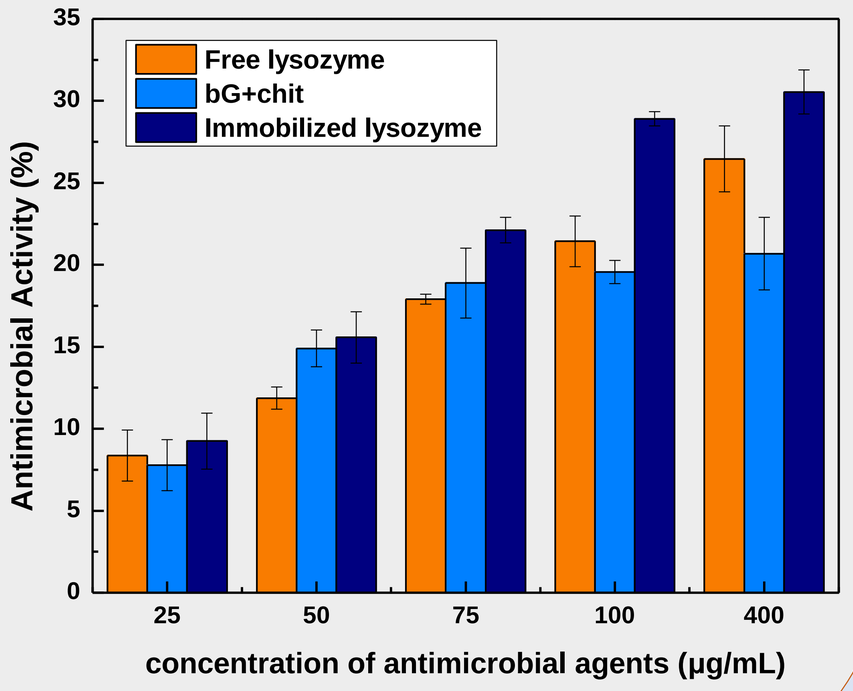


Figure 2. Antimicrobial activity of free lysozyme, bG+chit and immobilized lysozyme on E.coli

CONCLUSION

- ✓ Synthesis of green nanomaterial, biographene
- ✓ Production of hybrid intercalated biographene nanostructures
- ✓ Synthesis of a novel nanocomposite polymeric membranes for ultrafiltration processes with antimicrobial activity.

ACKNOWLEDGEMENTS

We acknowledge the support for this work provided by the project "Advanced Nanostructured Materials for Sustainable Growth: Green Energy Production/Storage, Energy Saving and Environmental Remediation" (TAEDR-0535821), which was implemented under the action "Flagship actions in interdisciplinary scientific fields with a special focus on the productive fabric" (ID 16618), Greece 2.0—National Recovery and Resilience Fund and funded by the European Union NextGenerationEU.

Greece 2.0 NATIONAL RECOVERY AND RESILIENCE PLAN

Funded by the European Union NextGenerationEU