IOCM 2025 Conference
The 4th International Online Conference on Materials
3–6 November 2025 | Online
MDPI

Biomedical Application of Polymer-Based Nano/Micromotors Synthesized by Electropolymerization Method

[1]Derya Bal Altuntaş
[1]Department of Bioengineering, Faculty of Engineering and Architecture, Recep Tayyip Erdogan University, Rize 53100, Türkiye

INTRODUCTION & AIM

This study presents the development of polymer-based nano/micromotors-SPE fabricated through electropolymerization for biomedical applications. Polymer-based motors were synthesized using template-assisted electropolymerization with optimized electrochemical parameters. The electropolymerization process was systematically characterized using cyclic voltammetry (CV) techniques to ensure reproducible fabrication conditions.To develop polymer-based nano/micromotors through electropolymerization and evaluate their biomedical applications including targeted drug delivery, bacterial removal, and biosensing [1,2].

METHOD

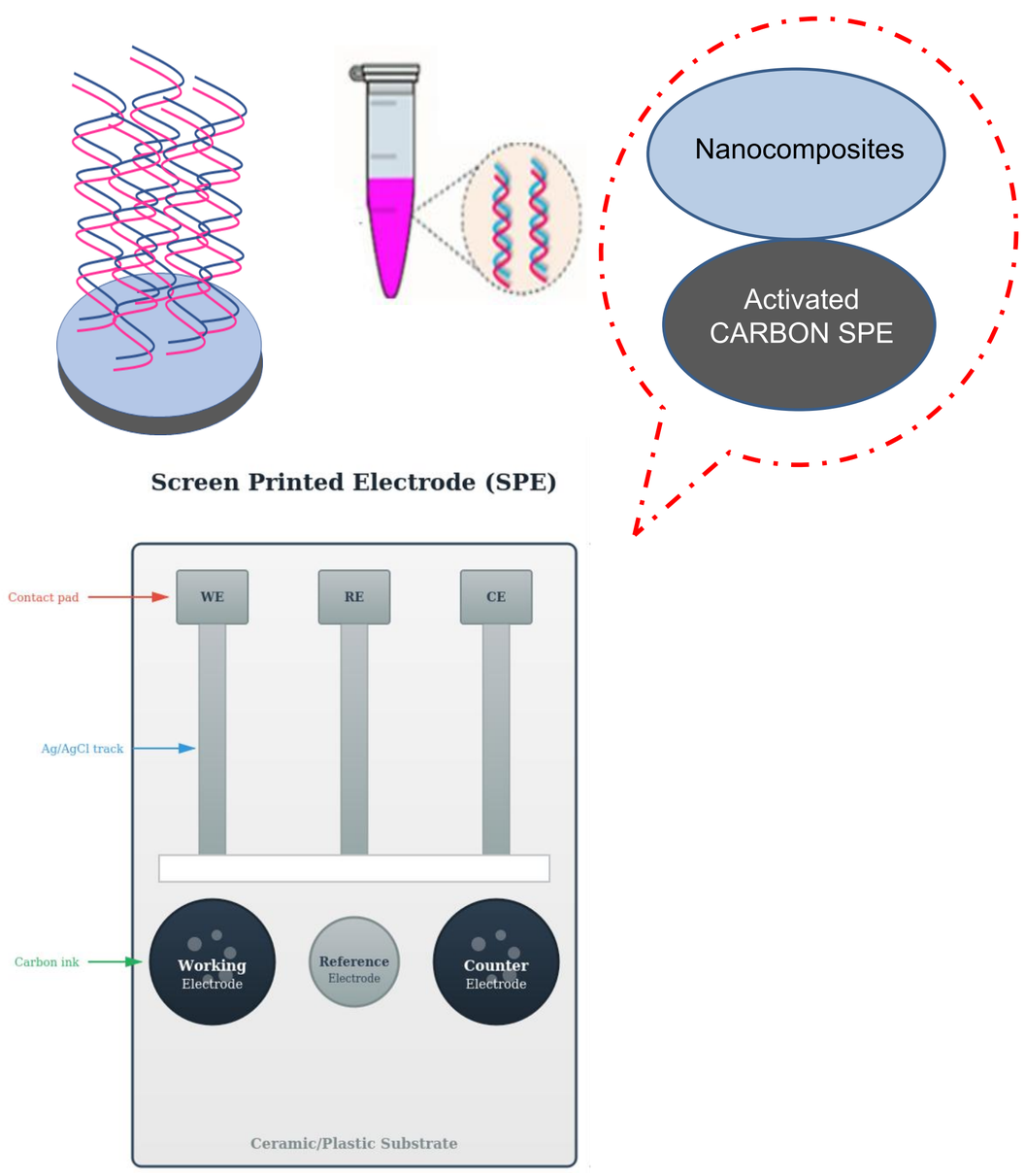
An AUTOLAB-PGSTAT 204 instrument from Metrohm, integrated with NOVA 2.1.4 software, was utilized to carry out cyclic voltammetry (CV) and differential pulse voltammetry (DPV) experiments. The electrochemical setup employed a three-electrode configuration featuring an Ag/AgCl reference electrode (containing 3 M KCl solution), a platinum wire auxiliary electrode (CH Instruments Inc. models CHI111 and CHI115), and a working electrode. Both unmodified and modified PGEs functioned as the working electrodes in these measurements.

- Template-assisted electropolymerization with optimized electrochemical parameters
- Systematic characterization using cyclic voltammetry (CV) techniques
- Surface modification strategies:
- Covalent attachment of bioactive molecules
- Incorporation of targeting ligands
- Electrochemical impedance spectroscopy for functionalization confirmation
- Comprehensive biocompatibility studies in cell culture
- Development of metallic bilayer variants
- Strategic incorporation of metallic nanoparticles into chitosan matrix
- Electrochemical surface functionalization for targeting capabilities

RESULTS & DISCUSSION

Fabrication & Characterization:

- Successful fabrication with reproducible conditions confirmed through CV
- Electrochemical impedance spectroscopy confirmed successful surface functionalization
- Maintained structural integrity of polymer matrix during fabrication processes



CONCLUSION

Results demonstrate the significant potential of electropolymerized polymer nano/micromotors as next-generation biomedical devices, offering unique advantages of controllable electrochemical propulsion, excellent biocompatibility, and complete biodegradability for various clinical applications.

FUTURE WORK / REFERENCES

[1]Baeza, A. and Vallet-Regí, M. (2018). Nanomotors for nucleic acid, proteins, pollutants and cells detection. International Journal of Molecular Sciences, 19(6):1579.
[2] Sanchez, S., Soler, L., and Katuri, J. (2015). Chemically powered micro- and nanomotors. Angewandte Chemie - International Edition, 54, 1414–1444