Tech Science Press

ICCES, 2024, vol.31, no.4
DOI: 10.32604/icces.2024.012578

PROCEEDINGS

Theoretical Modeling for Water Permeation Across Multilayer Films of Bioelectronic Systems

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ABSTRACT

Bioresorbable electronic devices represent an emerging class of technology that involves components which physically disappear, in whole or in part, at prescribed rates and at programmed times [1,2]. Obtaining reliable performance and favorable degradation behavior demands materials that can serve as biofluid barriers in encapsulating structures that avoid premature degradation of active electronic components [3–5]. We have recently presented a multilayer organic–inorganic film design that addresses this need, with properties in water impermeability, mechanical flexibility, and processability that are superior to alternatives [6,7]. Theoretical modeling for water permeation across the multilayer films provides an important design tool for such bioelectronic systems. In this talk, a class of reactive diffusion models for the analysis and design of such systems are reported, by which the key quantities such as water concentration distribution and lifetime prediction are obtained analytically. These models are well validated by the experiments and provide effective approaches to innovative designs of related devices.

KEYWORDS

Bioelectronic system; multilayer film; water permeation; theoretical modeling

Funding Statement: The authors received no specific funding for this study.

Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.

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