
Nanoscale Surface Engineering for Enhanced Cellular Interaction, Controlled Drug Delivery, and Biosensor Development

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Understanding and predicting the long-term biological responses of patients receiving implantable materials remains one of the paramount challenges in biomaterials science. By reconstructing and detailing these complex mechanisms, we aim to develop more targeted approaches to manipulate immune processes through synthetic biomaterials. Our research has explored the critical interplay between plasma-polymerized thin films and surface nanotopography, demonstrating that this synergy significantly influences cell-surface interactions. Specifically, we have shown that optimizing the combination of surface chemistry and nanotopography can modulate cellular adhesion, enhance collagen deposition, and influence macrophage polarization—affecting both pro-inflammatory and anti-inflammatory responses.

Furthermore, we have extended our surface engineering expertise by integrating nanoporous structures to innovate in controlled drug delivery systems and the fabrication of biosensors. These applications highlight the versatility and potential of surface engineering in biomedical contexts.

We anticipate that continued exploration in this field will lead to the rational design of biomedical implants and devices with nanoscale physicochemical characteristics. Such advancements promise to enhance utility and function, ultimately improving clinical outcomes.

I look forward to discussing these findings with you and exploring future collaborations in this exciting area of biomedical engineering.
