Between Blood and Biomaterial

Balancing Bioactivity and Immune Response in Small-Caliber Vascular Grafts

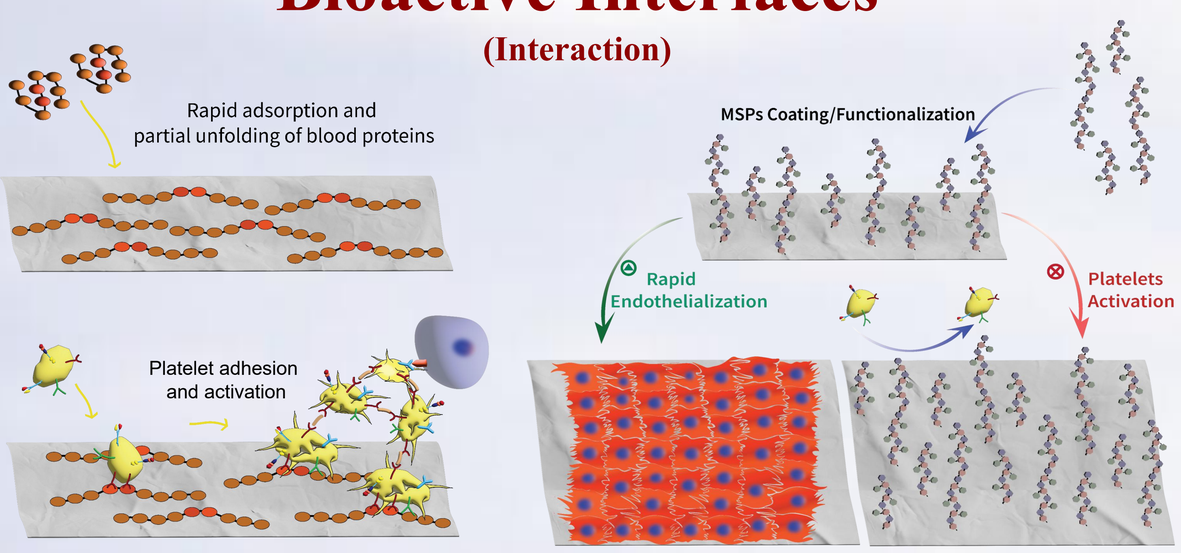
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Introduction: Surfaces capable of sustaining blood flow without triggering clot formation represent one of the most enduring challenges in the development of small-caliber vascular grafts. To achieve long-term patency, two opposing yet complementary design philosophies have emerged: one seeks to harmonize the material with biology by stimulating controlled tissue regeneration, while the other aspires to remain invisible to biological components—platelets, coagulation proteins, and immune cells—through anti-fouling, non-interacting interfaces

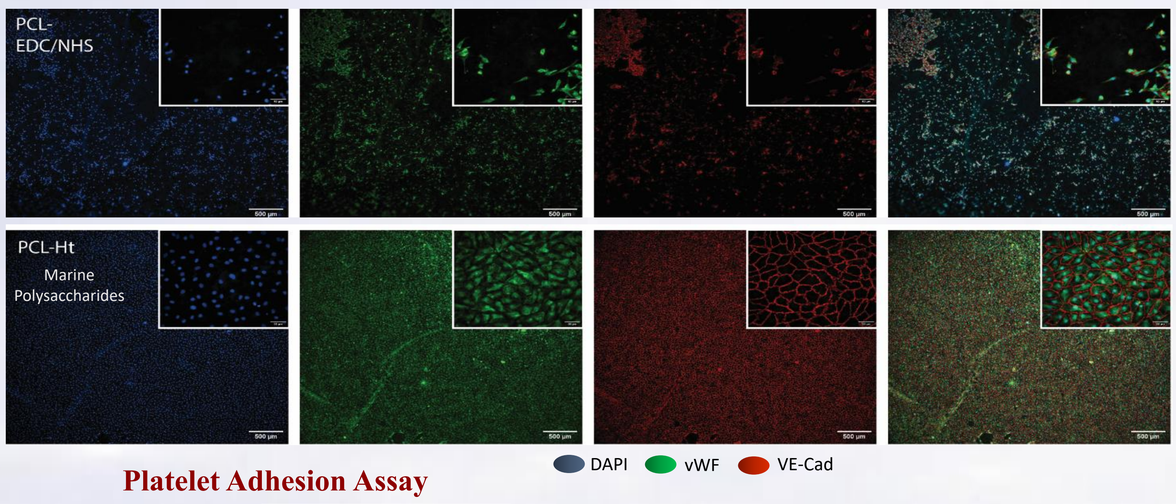
Bioactive Interfaces

(Interaction)

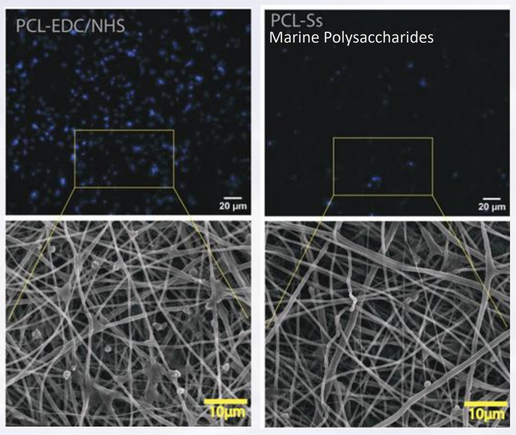


Marine sulfated polysaccharides were employed in bioresorbable biomaterials to enhance hemocompatibility and guide cellular behavior, promoting endothelialization and proper smooth muscle cell organization.

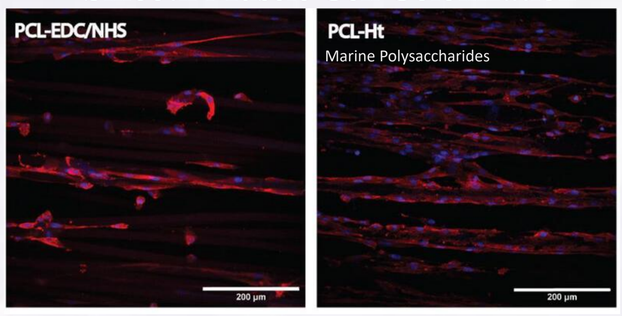
Endothelial Cell Colonization



Platelet Adhesion Assay

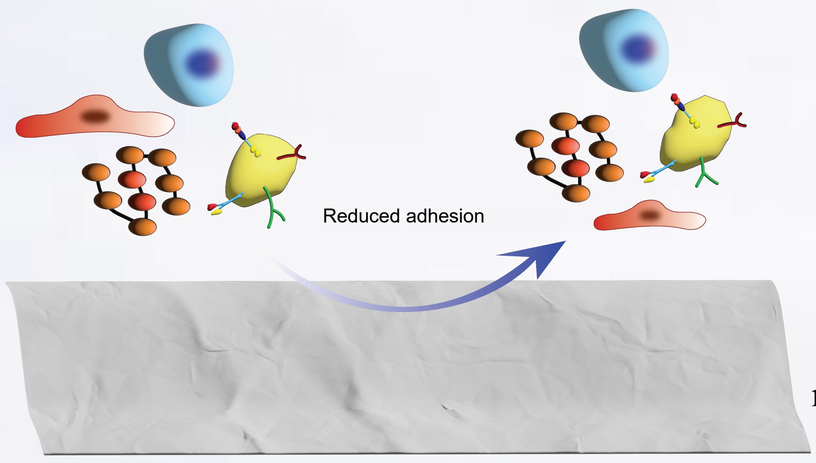


Smooth Muscle Cell Colonization



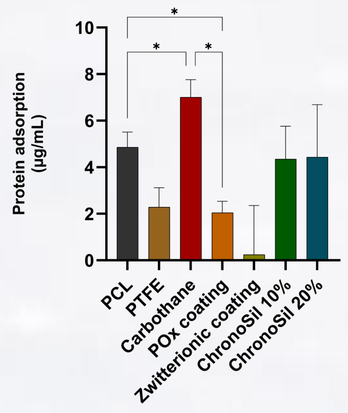
Anti-fouling Interfaces

(invisibility)

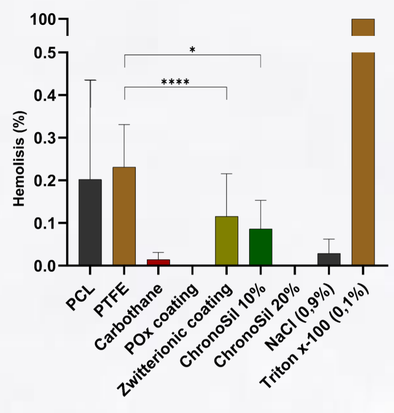


Non-biodegradable antifouling materials, including polycarbonate polyurethane and silicone-based copolymers, were employed alone or in combination with zwitterionic and poly(2-oxazoline) coatings to minimize protein adsorption and platelet adhesion

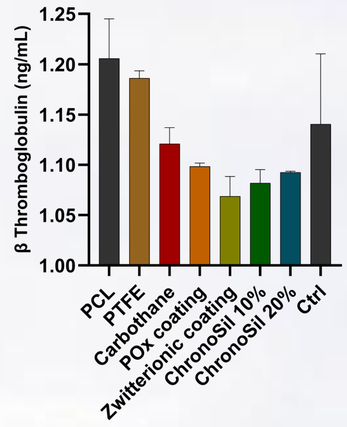
Protein Adhesion



Hemolysis

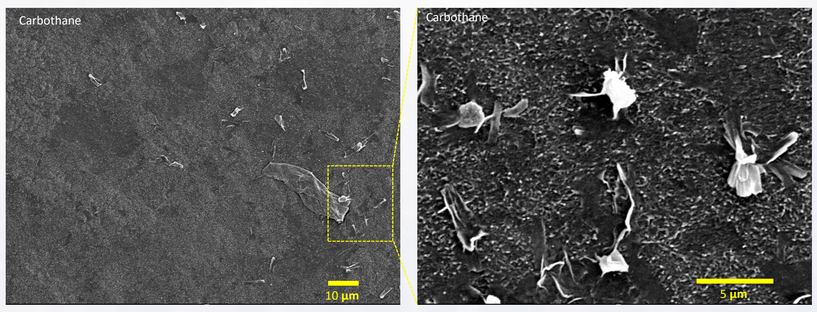


β - Thromboglobulin



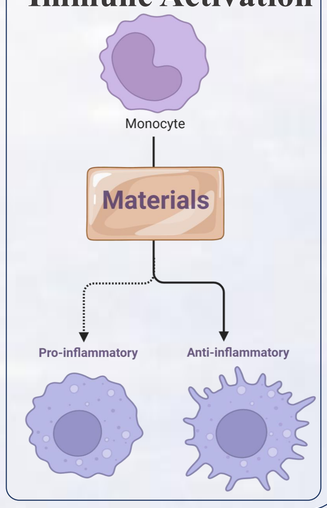
➢ Reduced protein adsorption limits the early activation of platelet and immune cells

Platelets Adhesion



Blood Compatibility Evaluation

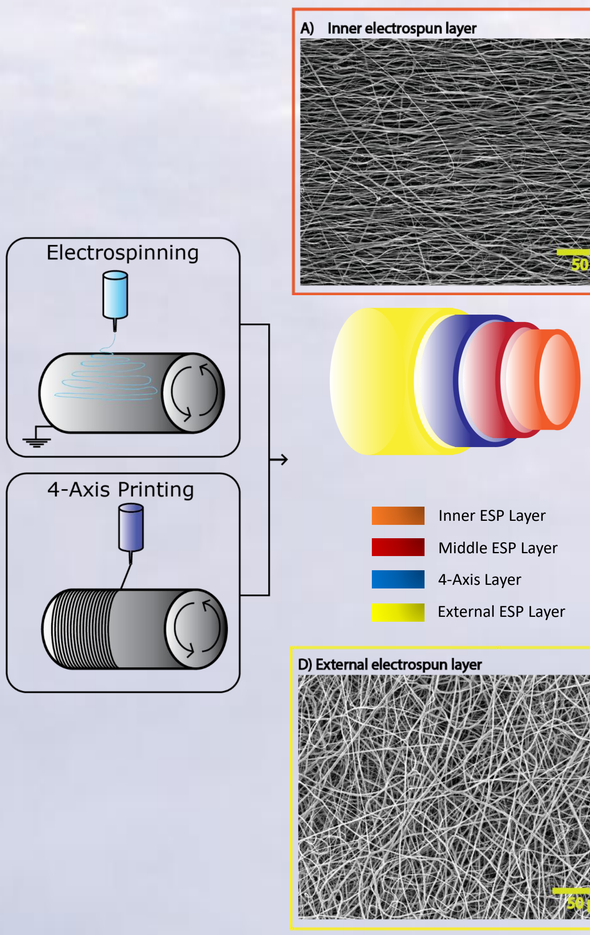
Toward Reduced Immune Activation



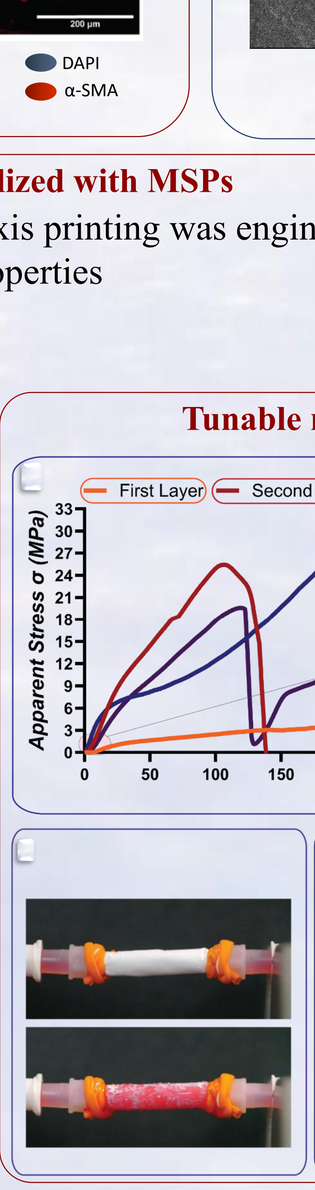
Biomimetic Multilayer Scaffold Functionalized with MSPs

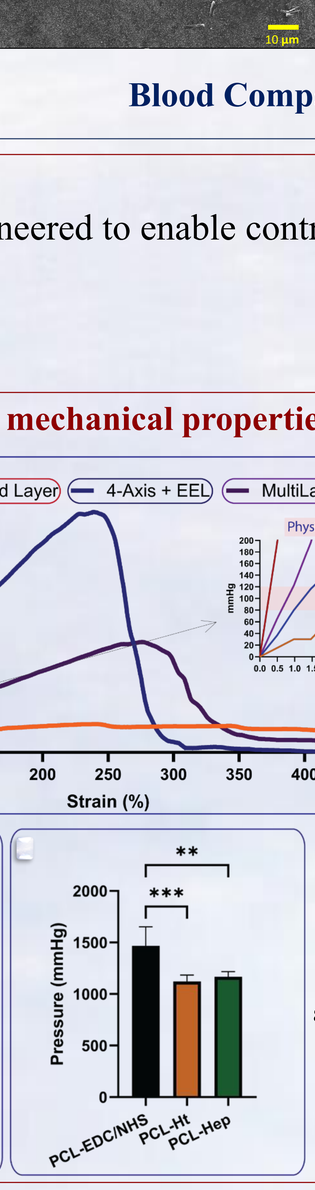
A biomimetic multilayer scaffold combining electrospinning and 4-axis printing was engineered to enable controlled cell infiltration, enhanced hemocompatibility, and tunable mechanical properties

Hybrid fabrication (electrospinning + 4 Axis printing)



Tunable mechanical properties





80-120 mmHg
Physiological
Pressure

Interaction and invisibility define complementary approaches to control blood–material interfaces and shape vascular graft performance

Scan for related publications and contact details

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