



Interactions between Biomaterials and Biological Tissues and Cells, Part I

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Biomaterials are those materials that are designed to mimic or replace biological materials. The interactions between engineered biomaterials and biological systems is a rapidly growing, interdisciplinary frontier in materials science and engineering with endless applications. The interactions can be physical, mechanical, biological, or biochemical. In these processes, the important issues include, but are not limited to, biointerfaces, mechanobiology, biocompatibility, tissue compatibility, inflammatory responses, biodegradation, toxicity, tissue regeneration, protein–materials interactions, and cell–material interactions.

This special topic presents a collection of reviews and original research papers related to the interactions between various biomaterials and biological tissues, cells, and molecules. The engineered biomaterials include metals, polymers, bioceramics, and their composites. The interactions with bone, ligament, fibroblasts, mesenchymal stem cells, and microbial cells are studied. The results shed light on biology, medicine, bioengineering, the food industry, and biomanufacturing, especially in artificial meat.

In the repair of injured ligaments and tendons, the fixation of grafts is crucial, because entheses between graft and bone is essential for musculoskeletal motion. In an original research paper, Dean et al. used inkjet-printing to create a graded

pattern of nanoparticulate hydroxyapatite on the surface of highly-aligned and chemically modified poly (lactic acid) (PLA) nanofiber scaffolds. Following immobilization of fibrin, they then demonstrated the proliferation and differentiation response of human mesenchymal stem cells (hMSC) in vitro on the surface of the samples.

In another original research paper, Bose and her team studied the effects of allicin, a molecule from garlic, on bone health by the fabrication of a novel allicin-loaded hydroxyapatite drug delivery system. The antibacterial efficiency against *S. aureus*, the allicin release kinetics, and the cytocompatibility with osteoblasts were investigated. The results indicated potential applications for the allicin-loaded scaffolds to be a localized delivery vehicle for bone tissue engineering.

Li et al. presented the results of experimental characterization of the biomechanical performance of two implant constructs for the realignment and arthrodesis of the first tarsometatarsal to address hallux valgus, a forefoot deformity. In their cadaver model, both constructs maintained compression and residual stability of the first tarsometatarsal joint gap. They provided statistically superior performance during loading compared to nitinol staples.

Implant-associated infection and antibiotic resistance is a challenge in biomedical materials' success in vivo. In an original research study, Roy et al. emphasized the need for exploring nanotopographies with good bactericidal efficiency. The crystallographic texture by dry etching of titanium showed bactericidal effect on both Gram-positive and Gram-negative bacteria.

Poly-ether-ether-ketone (PEEK) has evolved to be the preferred biomaterial for orthopedic implants; however, its bioinert nature significantly limits the implant's osseointegration property. In an original

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research paper, Gummadi et al. used 3D printing to develop PEEK scaffolds with precise pores ranging from 100 to 600 μm for future bone repair applications.

Curcumin is an active ingredient primarily found in turmeric which shows therapeutic drug properties, but its commercial use as a medication is unrealized, doubting its potency. In a review on curcumin-loaded electrospun nanofibers and their application in modern medicine, Mitra et al. discussed how polymer nanofibers interact with curcumin and its medical efficacy, with special emphasis on its release profiles, cell viability, and proliferation for efficacy in bone tissue repair and drug delivery against lung, breast, colorectal, squamous, glioma, and endometrial cancer cells.

The cellular attachment on polydimethylsiloxane (PDMS), a material that is commonly used in biomedical and microfluidic research platforms, has been hindered by its intrinsic hydrophobic property. Zhang et al. have investigated the effects of corona discharge treatment of PDMS. It was shown to improve the wettability, the cellular attachment, and the cell morphology on a PDMS substrate.

It is known in mechano-biology that substrate stiffness controls the cell cycle of hMSCs via cellular traction. Kureel et al. report on the microenvironment of hMSCs regulating their self-renewal and differentiation properties. The study suggests that substrate stiffness regulates hMSC proliferation through contractile forces, as generated by cellular contractile proteins in a unique pattern which is distinct from other cell types studied.

Conventional meat production faces issues related to butchering, dietary inadequacy, and foodborne disease. In vitro production on scaffolding and allied techniques are needed to produce artificial cultured meat frameworks on a large scale. Mateti et al. review the artificial meat industry: production methodology, challenges, and future prospects for making laboratory-grown meat industry a reality.

Many natural materials exhibit superior mechanical properties and provide inspiration for the design of layered materials. Inspired by nacre, a tough natural composite in the inner part of seashells, Tan et al. have fabricated and characterized composite samples that contain polymeric layers sandwiched between cementitious layers. The flexural strength and ductility were both shown to be improved.

To read or download any of the papers from this topic, follow the URL <http://link.springer.com/journal/11837/74/9/page/1> to the Table of Contents page for the September 2022 issue (vol. 74, no. 9).

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