P R O J E C T

MULTIFUNCTIONAL BIOMATERIALS

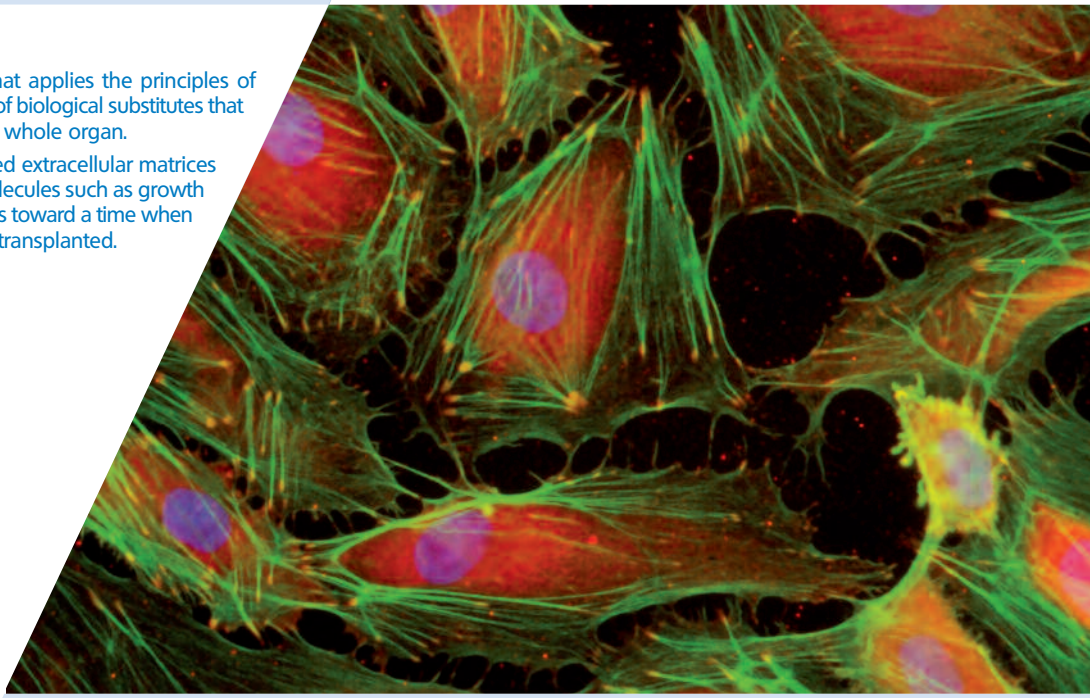
AND 3D ASSEMBLY FOR TISSUE ENGINEERING

AMA
ADVANCED MATERIALS IN AQUITAINE

CONTEXT

Tissue engineering is an interdisciplinary field that applies the principles of engineering and life sciences in the development of biological substitutes that restore, maintain, or improve tissue function or a whole organ.

Scientific advances in biomaterials and engineered extracellular matrices on scaffolds, stem cells, and biologically active molecules such as growth and differentiation factors represent significant steps toward a time when laboratory-grown tissues or organs are clinically transplanted.



Organisation of osteoblastic cells (MC3T3-E1) cytoskeleton on biofunctionalized polyethylene terephthalate (PET).

CHALLENGES

Advanced studies in cell-material interactions and tissue engineering have shown that the local cellular 'micro-environment' (10 μm) presents biochemical, cellular, and physical stimuli that orchestrate cellular fate through processes such as proliferation, differentiation, migration, and apoptosis.

- An appropriate environment for cell viability and function at the microscale-level
- Macroscale-level properties that allow sufficient transport of nutrients, provide adequate mechanical properties, and facilitate coordination of multicellular processes.

Traditionally, tissue engineering scaffolds have been composed of porous polymer or ceramic scaffolds acting as substrates on which cells are seeded, if necessary with growth and differentiation factors, before maturation in a bioreactor.

Numerous studies have shown that these strategies exhibit recurrent drawbacks since cell colonisation and vascularisation do not occur in the scaffold depth due to the weakness of 3D nutrient diffusion and difficulties in controlling the biochemical micro-environment.

MAIN OBJECTIVES

To develop an innovative tissue engineering route involving laser printing of nanomaterials, cells and biologically active molecules according to 2D-3D patterns defined by experimental approaches and numerical modelling.

SPECIFICITY

Our transversal approach combines:

- Experiments (nanomaterial synthesis, surface patterning and multi-functionalisation, cell-material interaction characterization)
- Technological developments (3D biological laser printer)
- Modelling (tissue growth)

to control over both the micro-architecture of tissues and the micro-environment around cells.

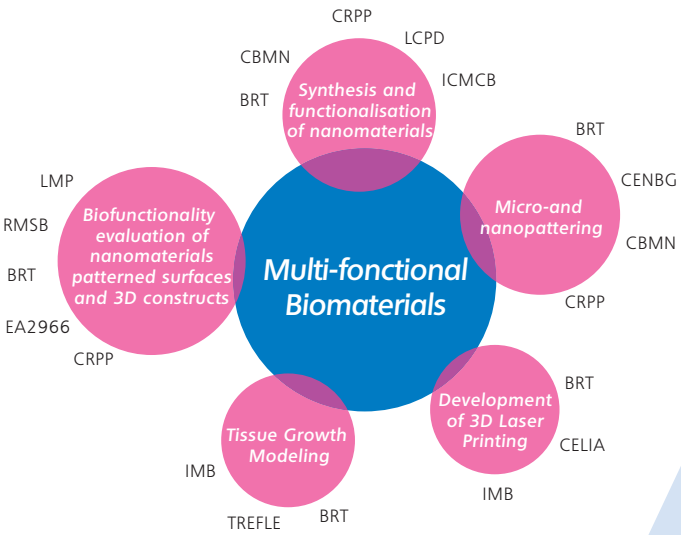
SCIENTIFIC AND TECHNOLOGICAL APPROACHES

- Synthesis of nanomaterials acting as mechanical supports, multimodal markers or bioactive agents
- Micro- and nano-patterning of biomaterial surfaces
- Development of high resolution and high throughput 3D laser printing methods
- Modelling tissue growth via advanced mathematical tools
- Studying biofunctionality of these complex constructs

APPLICATION FIELDS AND OUTCOME

To design engineered tissues with more complex functionality for regenerative medicine as well as for generation of physiological models for toxicology or pharmacokinetics experiments.

TASK ORGANISATION



COORDINATORS

Dr. Marie-Christine DURRIEU
Email: marie-christine.durrieu@inserm.fr
Phone: +33 5 57 57 11 15

Dr. Fabien GUILLEMOT
Email: fabien.guillemot@inserm.fr
Phone: +33 5 57 57 17 27

Biomaterials and Tissue Repair (INSERM U577)
Université Bordeaux 2, 146 rue Léo Saignat, F-33076 Bordeaux - France

PARTNERS

BRT: Biomatériaux et Réparation Tissulaire – Bordeaux
CRPP: Centre de Recherche Paul Pascal – Bordeaux
IMB: Institut de Mathématiques de Bordeaux
CELIA: Centre Lasers Intenses et Applications – Bordeaux
TREFLE: Transferts Écoulements Fluides Énergétique – Bordeaux
CENBG: Centre Etudes Nucléaires Bordeaux-Gradignan – Bordeaux
ICMCB: Institut de Chimie de la Matière Condensée de Bordeaux
CBMN, IECB: Chimie et Biologie des Membranes et Nanoobjets – Bordeaux
LCPO: Laboratoire de Chimie des Polymères Organiques – Bordeaux
LMP: Laboratoire de Mécanique Physique – Bordeaux
RMSB: Centre de Résonance Magnétique des Systèmes Biologiques – Bordeaux
EA2966 - NAM: Neurobiologie des Affections de la Myéline – Bordeaux

EXPERTISE AND KNOW-HOW

The project "Multi-functional Biomaterials and 3D assembly for Tissue Engineering" involves 12 laboratories from Aquitaine. It benefits from the strong expertise of each partner in its specific field:

- **BRT:** Biomaterials functionalisation, bioprinting and cell-material interactions
- **CRPP, LCPO, ICMCB:** Physics and chemistry of nanomaterials
- **CBMN, IECB:** Molecular imaging and nanobiotechnology
- **IMB, TREFLE:** Modelling in fluid mechanics
- **CELIA:** Numerical modelling of laser-matter interactions
- **RMSB:** *In vivo* bioimaging by NMR
- **LMP:** Optoacoustics by pump-probe measurments
- **CENBG:** Cellular response to charged particle irradiation, ion beam lithography
- **NAM:** Multiple sclerosis

www.aggelos.fr - janvier 2010