unibz Fakultät für Ingenieurwesen
Facoltà di Ingegneria
Faculty of Engineering

PRIME
PRIntable MatErials for sustainable optoelectronics & photonics

PRIntable MatErials for sustainable optoelectronics & photonics (PRIME)

PhD course	Advanced System Engineering (ASE)
Duration	3 years
Starting date	November 2024
Location	Bolzano-Italy
Project Title	**Engineering Biomaterials for 3D Bioprinting and Biohybrid Interfaces**
Supervisor	Dr. Manuela Ciocca (manuela.ciocca@unibz.it)
Co-supervisor	Prof. Franco Cacialli (franco.cacialli@unibz.it)
External supervisor	N/A

Project description:

The integration of engineered biocompatible materials with 3D bioprinting technology is revolutionizing the fields of tissue engineering and regenerative medicine. The development of biohybrid interfaces, combining living cells with engineered nanostructures, presents exciting opportunities for creating functional, responsive tissues. This PhD project aims to design and engineer novel bio-inks tailored for 3D bioprinting and optimize these materials for constructing biohybrid interfaces, focusing on light-responsive systems.

I. Objectives:

1. Design and development of novel Bioinks:

- Develop novel bioinks incorporating biocompatible, photoactive nanostructured materials (e.g., conjugated polymer nanoparticles CP-NPs).
- Tailor bioinks properties for optimal printability and living cells interaction.

2. Characterization of Bioinks:

- Conduct physicochemical (e.g., rheology, mechanical properties) and optoelectrical (e.g., absorbance, emission spectra) characterization of bioinks.
- Assess biocompatibility and biodegradability through *in vitro* studies.

3. Optimization of 3D Bioprinting Processes:

- Optimize 3D bioprinting parameters (extrusion pressure, speed, resolution).
- Improve CAD design for 3D printable scaffolds according to the desired application.

4. Development of Biohybrid Interfaces:

- Integrate living cells with 3D bioprinted photosensitive scaffolds.
- Investigate the functionality of the interfaces through biological assays.

II. Methodology:

- Functionalize hydrogel-based inks with photosensitive NPs to enhance cellular photoactivity.

- Design and print complex 3D tissue-like constructs with high spatial resolution.

- Use scanning electron microscopy (SEM), atomic force microscopy (AFM), and tensile testing for material characterization. Perform *in vitro* cell culture assays (cytotoxicity, proliferation, differentiation) to assess biocompatibility.

III. Expected Outcomes:

- Development of biohybrid photosensitive interfaces with potential applications in regenerative medicine.

- Enhanced understanding of the interaction between 3D-printed constructs and living cells.