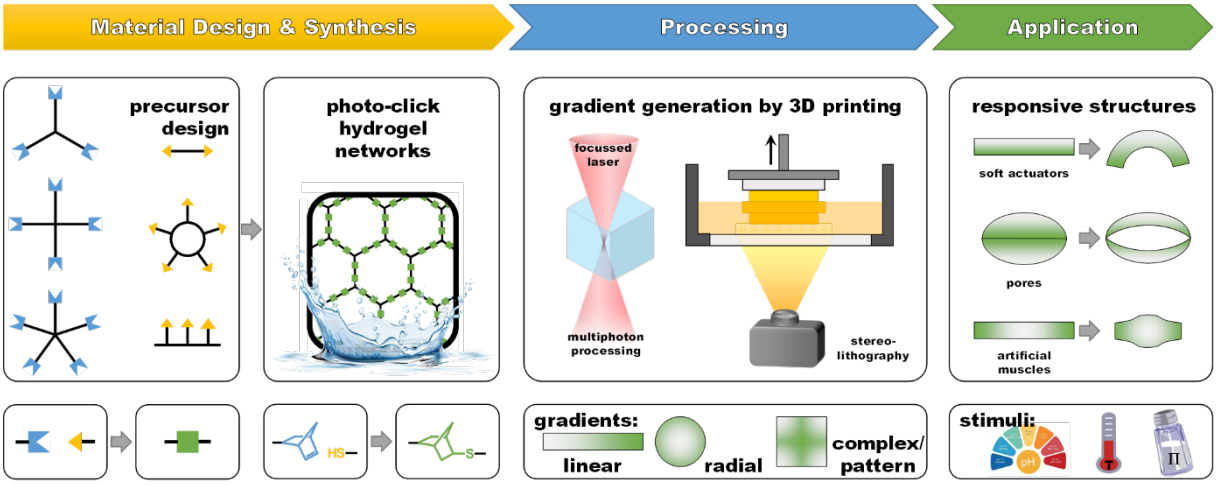
GRADIENT HYDROGELS: A MATERIAL PLATFORM FOR 4D TISSUE MODELS



Supervisory Team[1]

Primary Supervisor: *Stefan Baudis (Institute of Applied Synthetic Chemistry)*

TU Wien project partners: *Olivier Guillaume, Aleksandr Ovsianikov (both Institute of Materials Science and Technology), Christian Hellmich (Institute of Mechanics of Materials and Structures)*

External academic partners: *tba*

External industry partners: *Martin Schwentenwein, Lithoz GmbH*

Project Description

This PhD project focuses on the **design, synthesis and application of a material platform** based on **photocurable hydrogels**. By **fixation of gradients** in hydrogels by photopolymerization, bio-mimetic behavior can be triggered. These gradients are, e.g., linear, radical or follow a specific pattern and are - in the simplest case - gradients in crosslink density (adjusted by light intensity/exposure time), however, more interesting are gradients of tethering of (active) molecules/polymers/peptide to **change the physical/chemical/biological properties of the hydrogels continuously** in one, two or even three dimensions. This way, the **behavior of living tissue**, e.g., opening/closure of pores or change in curvature of membranes, can be mimicked by simple stimuli like change in temperature, pH or salt concentration. By exploitation of the possibilities of two-photon chemistry, this concept is well transferable to **high resolution 3D printing** processes.

[1] The Early Stage Researchers (ESRs) will be accompanied during their thesis by an individual "Thesis Advisory Committee" (TAC), which will guide the ESR through the graduate studies. The TAC will consist of the thesis primary supervisor, and two additional members of the Supervisory Team selected by the ESR.

Key Goals and Tasks

The primary aim of this PhD thesis is to **design and synthesize hydrogel precursors**. These precursors should enable the *in situ* generation of **hydrogel networks** by a certain trigger, in general **light**, but may also enable photodegrading existing networks or photo-tether (bio)active molecules with **spatial resolution**. This platform should then be exploited for the **fixation of gradients in 3D by using printing technologies** including stereolithography and two-photon polymerization. These gradients should **enable certain functions** and the final hydrogels should be able to **respond to external triggers**. For instances, a gradient in crosslink density renders hydrogels with different swellability throughout the material hence swelling leads to distinct (programable) deformation of the construct. This responsiveness should be examined thoroughly and exploited for **3D cell/tissue culture**.

Project-specific Requirements

- Completed master studies in chemistry
- Profound knowledge on organic synthetic chemistry and material characterization
- Experience and skills in molecular as well as macromolecular chemistry, compound purification and characterization with state-of-the-art analytical techniques (NMR, HPLC, UV-Vis spectroscopy, MassSpec, etc.), material characterization (rheometry/DMTA, universal testing, AFM etc.)
- Interest in working in an interdisciplinary field together with engineers, biologists and medicals.
- Enthusiasm for tissue engineering and regenerative medicine
- Affinity for acquiring additional knowledge and skills in adjacent scientific fields
- Willingness to travel to project meetings and scientific conferences
- Excellent language skills in spoken and written English
- Personal skills: Ability to perform research independently but also to work in a team, excellent communication time-management and problem-solving skills.