**Characterizing molecular self-assembly and macroscopic properties of hydrogels made from short peptides**

Hydrogels are 3D networks of hydrophilic polymers, polyelectrolytes, proteins or surfactants. They have a high ratio of water to dry gel and by swelling in water they expand by at least 10%, in volume or weight. They can be built responsive to environmental stimuli like temperature, pH, charge gradients or magnetic fields. Therefore, they fall into the realm of “smart soft matter”. Due to their highly porous microstructure, tunable mechanical properties and high surface area, hydrogels in principle offer broad applicability in a wide range of topics and bear potential in timely issues such as tissue engineering, energy storage, electronics and biosensors and drug delivery. However, how changes on the molecular and nanoscopic scale affect the macroscopic scale and properties is often intricate

The aim of the research in this project is to understand how one can rationally tune properties of small peptide-based hydrogels in themselves and by their interactions and inclusion of metal ions of different charge and chemical nature (transition metals, lanthanides etc.), or other small and intermediate-sized amphiphilic molecules. The tested properties may, e.g., consist of enhanced mechanical properties, sustained or expedited release or capture profiles of small molecules. The main aim will be to understand the molecular origins of the such-tuned (macroscopic) properties to derive a more holistic design principle based on interaction profiles of the gel-forming matrix and these gelation assistant molecules/ions.

These insights and understanding will be achieved mainly using continuous wave (CW) and pulse electron paramagnetic resonance (EPR) spectroscopy on a small fraction of admixed spin probes (such as stearic acid derivatives like 16-DSA), on paramagnetic transition metal ions directly and spin-labeled peptides. ATR-IR spectroscopy on the forming gels (in dependence of their incubation parameters) will give a view on potential secondary structure elements in the peptide-based gels and rheological measurements to study the mechanical properties during gelation, in the gel and subsequently for functional purposes.