Stimuli-responsive hydrogels are widely known in the field of intelligent materials for diverse applications, such as drug-delivery. By exceeding a substrate-specific transition zone, the solubility of the gel inside a certain medium is significantly changed, causing the gel to reversibly swell or collapse. This behavior can be used for specified targeting of the drug release upon reaching a certain state, for instance in pH and/or temperature.

This swelling behavior can also be used for different intelligent reactor designs, if integrated into defined geometries. Apart from flow adjustment or control, the responsive gels can also be used as catalyst carrier, where the accessibility of the catalyst is controlled via a stimuli from the reaction medium. The overall goal of this project is to conceptualize setups, where the stimuli-responsive hydrogel provides a self-regulating feature, which, in an ideal case, can substitute the process monitoring and control inside a reactor.

Responsive hydrogels are already used as flow control or micro pumps in many microfluidic systems. However, fabrication of individualized microsystem setups is time intensive. By introducing 3D-printed reactor geometries and multi-material templating, the integration of responsive hydrogels in millilitre volumes is enabled, which significantly increases throughput. Furthermore, the additive manufacturing allows fast fabrication of double-walled and intertwined reactors, which, in combination with responsive hydrogels, can be used for novel self-regulating reactor designs.