Formulation and characterisation of enzyme-based biomaterials for µFluidic experiments

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The fundamental principle of biological compartmentalisation of cellular life provides the basis for space-time resolved reaction processes. Based on this, intensive work is currently done on the use of interconnected, continuously flowing reaction chambers in order to improve the reaction control and efficiency of chemical syntheses, especially with the inclusion of biocatalysts (so called flow biocatalysis). Therefore, the Institute for Biological Interfaces IBG-1 aims at the formulation of enzyme-based biomaterials and the associated testing of novel gene-encoded coupling systems. The resulting enzyme fusions will be used as modular building blocks for the assembly of catalytically active materials, with different formulations (hydrogels or thin films) and characterized in terms of their immobilization and biocatalytic activity in miniaturized flow reactors.

During the process of formulating an optimised biomaterial, we developed and established the self-assembling all-enzyme hydogels (AEHs). These protein materials consist of the two homotetrameric enzymes, (R)-selective alcohol dehydrogenase (ADH) and the cofactor regenerating glucose 1-dehydrogenase (GDH), that are genetically fused with either the SpyCatcher (SC) or the SpyTag (ST). The AEHs were characterised via dynamic light scattering (DLS) and scanning electron microscopy (SEM) in terms of physical properties. Moreover, the gels showed excellent stereoselectivity, stable conversion rates and high space-time yields (STY) for more than seven days in continuous flow experiments.