LadHyX Seminar – May 16, 10:45

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Out-of-equilibrium microcompartments for the bottom-up integration of metabolic functions in population of artificial microsystems

Self-sustained metabolic pathways in microcompartments are the corner-stone for living systems. From a technological viewpoint, such pathways are a mandatory prerequisite for the reliable design of artificial cells functioning out-of-equilibrium. We develop microfluidic platforms for the miniaturization and analysis of metabolic pathways in man-made compartments formed of water-in-oil droplets [1,2,3]. In a modular approach, we integrate a nicotinamide adenine dinucleotide (NAD)-dependent enzymatic reaction and a NAD-regeneration module as a minimal metabolism. We show that the functionalized microcompartments sustain a metabolically active state until the substrate is fully consumed. Reversibly, the external addition of the substrate reboots the metabolic activity of the microcompartments back to an active state. We therefore control the metabolic state of thousands of independent monodisperse microcompartments, a step of relevance for the construction of large populations of metabolically active artificial cells. The next challenges would be the coupling of our chemical functionalization with mechanical functions to design active micro-systems with life-like properties.

[1] Beneyton et al. *Out-of-equilibrium microcompartments for the bottom-up integration of metabolic functions*, Nature Communications, **9**:2391 (2018)

[2] Schwille et al. *MaxSynBio-Avenues towards creating cells from the bottom up*, Angewandte Chemie Int Ed **57**:13382 (2018)

[3] Weiss et al. *Sequential bottom-up assembly of mechanically stabilized synthetic cells by microfluidics*, Nature Materials, **17**:89 (2018)