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GRK 2516 Soft Matter Seminar

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Minkowski Room, 05-119, Staudingerweg 7

Research seminar of the DFG Research Training Group GRK 2516 (https://grk2516.uni-mainz.de).

Swapnasopan Datta
JGU, Chemistry

Transient Coacervation away from Equilibrium under Compartmentalization

Conventional chemistry deals with reactants that lead to stable molecules following a classical equilibration pathway. The same holds for classical self-assembly processes, in which non-covalent interactions lead to assembly according to thermal equilibration. There are also a number of systems that reach a metastable state momentarily, and subsequently jump to another lower energy state. In supramolecular systems, this is called pathway complexity. The propensity to transition from a metastable state to an equilibrium state is a function of the energy barrier with respect to thermal energy. This is fundamentally different from the far-from-equilibrium way living systems work, which can be achieved by employing a ‘fuel’ which drives a system to a high energy state and coupling it with an environment which can bring the system back to the original state. Keys to non-equilibrium behaviour are the mechanisms through which systems are able to extract energy from the chemical reactants (‘fuel’) that drive such processes. In our group, a fuel driven enzyme mediated reaction network was established where a ligation reaction occurs followed by a dynamic steady state, whose lifetime depends on the fuel concentration and dynamics is decided by the ratio of the ligation and restriction enzymes, and finally the restriction process dominates giving back the monomers. This is achieved in our case by using ATP as a fuel which activates a ligation enzyme leading to formation of DNA polymers which get cleaved by the restriction enzyme giving back the monomers. By tuning the interactions between these polymers, one can give rise to multivalent DNA coacervates which phase separate as a function of time and eventually vanish when the restriction step dominates. This liquid liquid phase separation (LLPS) process is fundamentally different from conventional coacervation in that it occurs as a result of interaction between polymers which are at a very high energy as opposed to thermodynamically stable phase separation. In this talk I will talk about trapping such a reaction

module inside a ‘protocell’ which is a simple mimic of a real cell and explore the possibility of making a synthetic cell bottom up inside which transient LLPS might occur. For this project, we are using liposomes as cell mimics as the phospholipid bilayer which they contain closely resembles a cell.

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