Cooperative self-assembly in origin of life

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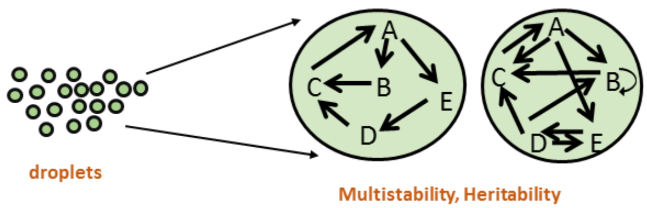

Self-assembly and network formation in droplets

Self-assembly must have been an intriguing feature of prebiotic molecules to generate first life-like scenarios on Earth. Both small molecule-based chemical systems as well as RNA are shown to possess self-assembly properties to generate more complex prebiotic-relevant products.[1]
Recent works has shown how small RNA fragments of *Azoarus* group I intron spontaneously self-assemble to form fully-functional ribozymes in a cooperative and autocatalytic fashion,[2,3] overcoming the hurdle of error-catastrophe in a pure replication-based origin-of-life system.[4,5] However it is not clear whether such system can show Darwinian-like evolution, specifically hereditability, a key feature for any kind of life to develop on Earth. Exploring heritability involves examining how the final state of a system depends on the initial state which has been transmitted from a previous system to later, analogous to genetic material transmission & replication.
In this work,by exploring huge diversity of initial states and their progress towards the final state when each of them is provided with same material to self-assemble, we are addressing two main questions 1) Multistability: whether these diverse starting initial states leads to development of multiple final stable-states or rather converge to a single universal state? Having multiple states competing for common resource is more origin-of-life relevant than mere dependence of system state on environmental conditions. 2) Heritability: whether the observable effect of initial state on final state can be propagated to next generations. To address these issues we have developed a high-throughput experimental set-up by combining droplet-microfluidics[6,7] with next-generation sequencing where we will have unprecedented resolution for millions of self-assemblies of *Azoarcus* RNA fragments in droplets. Initial results on a sub-set of conditions show that there is strong effect of initial state on the final state. Now we are exploring full-diversity of *Azoarcus* RNA fragments to identify all the possible states and their heritability.

References

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