Indian Institute of Science
Centre for BioSystems Science and Engineering
BSSE Seminar

27th August 2019, 11:00 AM, Tuesday, MRDG Seminar Hall, 1st floor, Biological Sciences Building

On - Chip Soft Biosystems

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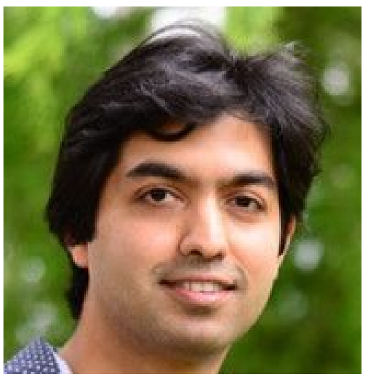
ABOUT THE SPEAKER



Dr. Siddharth Deshpande received his Ph.D degree in Biophysics, while working under Dr. Thomas Pfohl at the University of Basel, Switzerland. Currently, he is carrying out his postdoctoral research in Synthetic Biology under the Department of Bionanoscience at the Kavli Institute of Nanoscience Delft in the Netherlands. He will be joining the Leibniz Institute of Polymer Research in Dresden, Germany in the month of November this year. His interests and expertise lie in soft matter (from membranes to cytoskeleton), bottom-up biology, and on microfluidic technology. His future research vision is to improve our fundamental understanding of cytoskeleton-based cellular morphogenesis and its link with phase separation through a bioengineering approach. His research has the potential to impact the emerging applied field of soft robotics and build bottom-up model systems to understand cancer metastasis and neurodegenerative diseases.

ABSTRACT

The emerging field of synthetic biology is set to provide new avenues to help understand how living systems work and whether such systems can be synthesized or re-designed. In this talk, I will present the production, growth, and division of cell-mimicking containers, as well as an effective way to compartmentalize and thus increase the complexity of such soft matter-based objects. I recently developed a versatile microfluidic method, Octanol-assisted Liposome Assembly (OLA), which produces cell-sized, monodispersed, unilamellar liposomes with an excellent encapsulation efficiency. These liposomes can be further manipulated according to the need, such as immobilization via physical traps or shape manipulation by squeezing them into narrow confinements. Using OLA, we have realized a new way of achieving liposome division using a purely external mechanical force, thus, providing a simple way to achieve symmetric, efficient, quick, and protein-free division of cell-sized liposomes. We recently succeeded in inducing liposome growth by recruiting lipids from the external environment. We achieved this by membrane fusion of small unilamellar vesicles to the stressed membrane of mother liposomes. Living cells contain numerous membraneless organelles (biomolecular condensates), which help regulate intracellular biochemistry and are formed as a result of liquid–liquid phase separation. We used protein-pore-mediated permeation of small molecules into OLA-based liposomes to trigger the phase separation process and form freely-diffusing condensates inside liposomes. We further demonstrated their functionality such as their ability to sequester specific components as well as the possibility to host chemical reactions. Such hybrid systems open interesting opportunities to build synthetic cells of higher complexity and also as a tool to study the intracellular phase behavior. Thus, I will present my take on how on-chip microfluidic systems provide an attractive technology when it comes to designing synthetic cells and understand cellular biology in a bottom-up fashion.