IAP Seminar

Tom Robinson

Max-Planck-Institute of Colloids and Interfaces, Potsdam/Germany

Tuesday, 7th March 2023, 16:00 s.t.
TU Wien, Institut für Angewandte Physik, E134
1040 Wien, Wiedner Hauptstraße 8-10
Yellow Tower „B“, 5th floor, SEM.R. DB gelb 05 B

The seminar will be also held as a Zoom Meeting

https://tuwien.zoom.us/j/63134603386?pwd=dHhWdkZ0TEVxUmYwRTRQRFpLTjE0QT09
Meeting-ID: 631 3460 3386
Passwort: Ln2UQFfY

Engineering artificial cells from the bottom-up using microfluidics

One of the aims of synthetic biology is the bottom-up construction of synthetic cells from non-living components. Building biomimetic cells and controlling each aspect of their design not only provides the opportunity to understand real cells and their origins, but also offers alternative routes to novel biotechnologies. Giant unilamellar vesicles (GUVs) are commonly used as scaffolds to construct synthetic cells owing to their compatibility with existing biological components, but traditional methods to form them are limited. Microfluidic-based approaches for GUV production show great potential for encapsulating large biomolecules required for mimicking life-like functions (Yandrapalli et al. Micromachines, 11, 285, 2020; Love et al. Angew Chemie, 59, 5950–5957, 2020). First, I will present a microfluidic platform that is able to produce surfactant-free pure lipid GUVs in a high-throughput manner (Yandrapalli et al. Commun Chem, 4, 100, 2021). The major advancement is that the lipid membranes are produced in the absence of block co-polymers or surfactants that can affect their biocompatibility - which is commonly overlooked. The design can produce homogenously sized GUVs with tuneable diameters from 10 to 130 µm. Encapsulation is uniform and we show that the membranes are oil-free by measuring the diffusion of lipids via FRAP measurements. Next, I will present how we modified this device to encapsulate two sub-populations of nano-sized vesicles for the purpose of establishing enzymatic cascade reactions across membrane-bound compartments, therefore mimicking eukaryotic cells (Shetty et al. ACS Nano, 15, 15656, 2021). The final synthetic cell comprises three coupled enzymatic reactions, which propagate across three separate compartments in a specific direction due to size-selective membranes pores. Not only does microfluidics provide a high degree of control over the intra-vesicular conditions such as enzyme concentrations, buffers, and the number of inner compartments, but the monodispersity of our synthetic cells allows us to directly compare the effects that compartmentalization has on the biochemical reaction rates and product yields. This work demonstrates the effectiveness of microfluidics for the bottom-up assembly of synthetic cells, and paves the way for novel biotechnologies in areas such as compound production, sensing, and drug delivery.

All interested colleagues are welcome to this seminar lecture
(45 min. presentation followed by discussion).

Friedrich Aumayr
(LVA-Leiter)

Markus Valtiner
(Seminar Chair)