

Seminar

Programmable Synthetic Cells to Functional Cytomimetic Materials

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Cells are considered as basic building blocks of life which function as highly advanced and complex microreactors. The living cells utilise built-in genetic regulatory networks to recognise, sort, and process complex signals and/or respond to their environmental changes to exhibit higher-order functionalities such as metabolism, growth, division, motility, cell-cell communication etc. This has inspired researchers to construct synthetic analogues of natural cells called protocells. Protocells are simplified, cell-like structures that mimic essential properties of living cells yet lack their complexities. They represent a pivotal step in the study of origin of life bridging the gap between prebiotic chemistry and early cellular structures. This is an emerging field where the bottom-up construction of soft compartments with integrated biomimetic functions generate life-like behaviours.

In our research, we have designed and synthesised a variety of membraneless and membranous synthetic cells which could be employed to translate rudimentary properties of natural cells to artificial cells. These protocells are shown to sequester range of biotic and abiotic functional molecules to be employed as programmable protocells. We have been able to achieve bioinspired functions where the protocells have been engineered to receive, sort and process biochemical signals to execute Boolean logic operations. Moreover, wall modified membranous protocells have also been employed to construct protocell-based flow-reactors and generate integrated assemblies of artificial tissues or prototissues. These synthetic tissues were also shown to achieve bioinspired functions such as information processing, programmable protocellular assemblies and even complex responses such as breathing. Moreover, the incorporation of living cells with artificial cells results in intercellular communication giving biohybrid functional systems. We envisage that such artificial cytomimetic materials could be used for clinical applications.

Tuesday, Oct 28th 2025

16:00 Hrs (Tea / Coffee 15:45 Hrs)

Auditorium, TIFRH