Active vesicle as synthetic cell and their role in peptide/protein self-assembly

Prof. Mohit Kumar
Faculty of Chemistry,
University of Barcelona
mohit.kumar@ub.edu

Chemical reactions in living systems are regulated by metabolic processes like the anabolic formation of bio-macromolecules and catabolic degradation of food into energy. These reactions often consume chemical energy and result in active self-assembled structures that exist under out-of-equilibrium (OOE) conditions, which facilitate unique functions of life. In specific, phospholipid molecules of cellular membranes are formed and sustained under OOE, which consume chemical energy to constantly form and breakdown the phospholipids. This provides unique properties like cellular plasticity, spatiotemporal control and regulate protein aggregation on cell surfaces.

In this talk, I will discuss a bio-inspired supramolecular system that forms transient lipid vesicle under OOE conditions, by consuming chemical energy, to result in vesicles with programmable lifetimes. We use simple imine chemistry for the formation of phospholipids and enzymatic ester hydrolysis for the degradation of lipids and the resultant vesicle. We will also demonstrate that the lifetime of these structures can be easily regulated based on the requirement. We are working towards using these active vesicles as an adaptive interface for targeted drug delivery. Finally, we will show how active vesicles can act as a scaffold for the self-assembly of peptides and proteins. These have implications in trying to understand how protein like Tau aggregates on active cellular surfaces like neuronal surface.

References: