School of Natural Sciences Chemistry Seminar Series

UCMERCED

New Applications of Cellulose Paper in Synthetic Biology and Quantitative Diagnostics

Date:

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Time:

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Location:

COB 267

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Abstract:

Building simplified in vitro models of complex biological systems is a promising model for understanding cellular processes. Our lab is currently investigating mechanisms for building the cell membrane by fabricating bioinspired giant liposomes from purified lipids. These giant liposomes — through the entrapment of appropriate enzymes, ribosomes, DNA, and cytoskeletal components — can recapitulate complex cellular processes. In this talk, I will report on our latest discovery that drying lipids onto commercially available cellulose paper and then rehydrating them in aqueous buffers allows rapid formation of giant liposomes. The optimized protocol, which we term PAPYRUS for Paper-Abetted liPid hYdRation in aqUeous Solutions, is general, and can produce liposomes in various aqueous media and at elevated temperatures. Encapsulation of macromolecules and production of liposomes with membranes of complex compositions is straightforward. The use of cellulose paper as a materials-based platform for the production of liposomes is a significant departure from current methods and greatly simplifies the procedure for fabricating these bioinspired structures. Although the formation of liposomes on paper is straightforward, a mechanistic understanding of the process is somewhat subtle. We have found that the swelling capacity of cellulose and electrostatic interactions between the lipids is critical for the formation of the liposomes, and that a nano-modification of the cellulose fibers dramatically increases the size and yield of the liposomes. If time permits, I will also discuss my labs recent work on using cellulose-nanocelluose hybrid paper devices for quantifying the concentration of specific proteins in complex biological fluids in a label-free, power-free format.

Bio*:*

Anand Bala Subramaniam is an assistant professor in the School of Engineering at the University of California, Merced. Dr. Subramaniam received his PhD degree in Applied Physics from Harvard University in 2011 under the direction of Prof. Howard Stone and Prof. Vinothan Manoharan. His work focused on fundamental and collective properties of soft and biological materials: how colloidal particles assemble on fluid/fluid interfaces, how surfactants affect the stability of particle-stabilized foams and emulsions, how wetting transitions could lead to prebiotic inorganic cell membranes, studying the effects of geometry and curvature on biomembranes, and the effects of polysaccharides on the phase behavior of biomembranes. In his postdoctoral appointment in the George Whitesides Group, he applied his background in fluids, colloids, and soft matter to develop two novel low-cost methods for conducting immunoassays. His lab at UC Merced is studying active soft interfaces and exploring the role of emergent complexity in soft biological systems, which includes topics such as deciphering the effects of polysaccharides on lipid membranes, developing new ways of producing cell mimetic capsules to produce synthetic cells for in vitro reconstitution, and using unconventional modalities to develop novel biosensors.