UC San Diego

JACOBS SCHOOL OF ENGINEERING
NanoEngineering

UC SAN DIEGO NANOENGINEERING SEMINAR

Wednesday, January 16th, 2019
Seminar Presentation: 11:00am – 12:00pm
SME 248

"Protein encapsidation and delivery within recombinant virus-derived protein cages"

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Abstract: The use of viruses and recombinant virus capsids, or virus-like particles (VLPs), as nanoscale componentry shows great potential in diverse application areas including biocatalysis, immunotherapy and therapeutic delivery. As supramolecular assemblies, VLPs boast unrivalled structural precision and biocompatibility as well as benign manufacturing conditions. Owing to the high-resolution structural knowledge that exists for several VLPs, they represent a powerful platform for rational bioengineering by both genetic and chemical means. I will present recent work to control protein encapsidation with two platforms, Bluetongue virus (BTV) core-like particles and Murine Polyomavirus (MPyV) VLPs. Each has a unique set of characteristics that define their suitability to different applications. Determining the structure of BTV cores by Cryo-EM has shown them to be remarkably stable and suited to expression in plant hosts. Unusual colloidal properties points to their potential use as recoverable biocatalytic nanoreactors. The *in vitro* self-assembly of MPyV VLPs permits the controlled, stoichiometric co-encapsidation of non-covalently anchored cargo proteins. The infection pathway of MPyV is mimicked by VLPs, pointing to use as intracellular protein delivery vehicles. Biophysical techniques such as Förster resonance energy transfer (FRET) between co-encapsidated fluorescent proteins, nanoparticle tracking, and super resolution microscopy has shed light onto the co-operative self-assembly process of VLPs and the impact of encapsidating protein cargo on self-assembly.

Biosketch: Dr. Frank Sainsbury's research is focused in the areas of biomolecular engineering, protein self-assembly, plant biotechnology and nanotechnology. During his PhD at the John Innes Centre in the UK, he invented a technology that enables the rapid production of virus-derived biomaterials in plants. The technology currently supports the commercial manufacture of virus-like particle vaccines in Phase III clinical trials. During a postdoc at Laval University in Canada, Dr. Sainsbury worked with industry to help pioneer the use of synthetic biology to modify whole plant hosts for recombinant protein production. In 2014, Dr. Sainsbury took up a prestigious Australian Research Council Fellowship at the Australian Institute for bioengineering and Nanotechnology to study protein self-assembly and protein-based nanotechnologies for intracellular delivery, molecular imaging and vaccine design. Dr. Sainsbury has recently started a Commonwealth Scientific and Industrial Research Organisation Fellowship to further his work on the self-assemble of virus-like particles and the role of nanoscale geometry on biochemical processes.