Department of Chemistry
The University of Western Ontario

PAUL de MAYO AWARD LECTURE

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Chemically Reactive Protocells: A Bottom-up Approach to the Construction of Prototissues

Thursday, May 25, 2017 at 2:30 pm
Room 0165, Biological & Geological Sciences Building

In recent years, the field of synthetic biology has developed different models of cell-like entities (*protocells*) through a bottom-up approach. However, the development of 3D protocellular networks (*prototissues*) with high spatial and temporal order, and the ability to display a greater sophisticated behaviour still represents a challenge in the field. The achievement of such a biomimicking system will represent an important scientific and technological advancement, but it requires the development of synthetic techniques that allow for the construction of resilient contacts between the protocell building blocks.

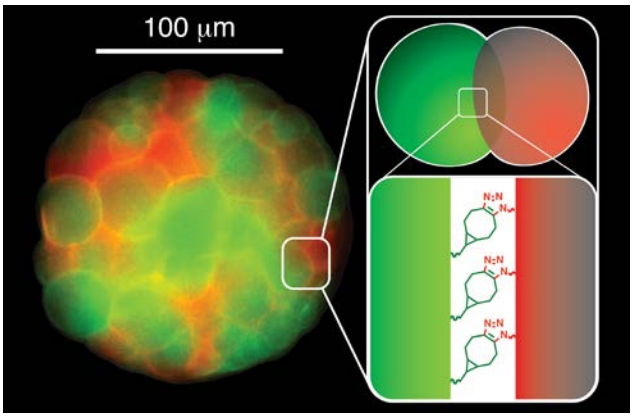

Figure 1: Fluorescence microscopy image of a 3D proteinosome spheroid. The inset shows a schematic representation of the system and highlights the covalent ligation that holds the proteinosome building blocks together

I will show that it is possible to spatially organize protocell communities by inducing a chemoselective and resilient (covalent) protocell-protocell adhesion. Our protocell template is represented by *proteinosomes*, which are micro-compartments composed of a protein-polymer nano-hybrid material and are capable of selective permeability, membrane-gated enzyme catalysis and gene-directed protein synthesis. The novel methodology relies on the surface engineering of proteinosomes using azide or strained-alkyne functional groups for subsequent bio-orthogonal alkyne-azide ligation. The organization of the bio-orthogonal proteinosomes into well-defined 3D spheroid assemblies (see figure) is then achieved by developing a technique to spatially constrain restricted groups of proteinosomes and promote their interfacial ligation. Investigation of the collective (mechanical, communication, sensing and catalytic) properties of these novel tissue-like materials will also presented.

This approach to the construction of well-defined 3D spheroidal protocellular architectures will find applications in tissue engineering, drug delivery and in the development of micro-bioreactor technologies. Moreover, the use of ligation chemistry as a means to promote protocell-protocell adhesion will also provide a better understanding of the spatial organization phenomena used by native cells, leading to the next generation of biomimicking materials.

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