New paradigms in bio-inspired materials chemistry: biomimetic potential at the proto-life/synthetic biology interface

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The fundamental understanding of living systems as an integrated network of functional compartments and components serves as a powerful paradigm in the bio-inspired synthesis and design of novel materials structures and processes. Such an approach not only provides an expanding platform of new materials for specific applications, but also inspires advances in more tangential areas such as at the interface of synthetic biology and protocell modelling.

In this talk, I review some recent studies undertaken in my laboratory that provide alternative bioinspired approaches that address the interface between proto-life research and synthetic biology. Two themes will be considered. Firstly, can proteins with biomimetic potential maintain their structure and function in the absence of water (or any other solvent) whilst retained in the liquid state? And secondly, can protocell models be constructed based on bioinspired materials design and construction?

Specifically, I will describe our current studies on the first known examples of solvent-less liquid proteins [1-3], including studies on the dioxygen binding and temperature-dependent chain unfolding properties of liquid myoglobin. Then I will discuss our recent investigations on artificial protocells that are derived from organic self-assembly [4], nanoparticle-based membrane assembly [5] or membrane-free condensed microdroplets [6,7], and illustrate respectively how such structures can be used to accommodate primitive cytoskeletal-like hydrogels, as bio-inorganic nanoparticle-based reactors for enzyme catalysis and *in vitro* gene expression, or as a plausible micro-droplet model of pre-biotic organization.

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