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Bio-inspired self-assemblies: from artificial chaperones to responsive protocells

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Biology provides an endless source of inspiration for research in physical sciences. Significantly, biological systems rely on finely tuned molecular recognition processes and involve dynamic networks of biochemical and physical processes precisely triggered in space and time. Molecular self-assembly is thus a promising and modular tool to approach biological complexity and build artificial ensembles with advanced and controllable functional properties. This talk will examine how non-covalent interactions between molecular components can be rationally exploited to shed light on biological processes and design new functional assemblies. Taking inspiration from Nature, I will first introduce the use of transient interactions between amphiphilic polyelectrolytes and proteins to develop “artificial chaperones”, synthetic systems capable to stabilise aggregation-prone protein intermediates formed during protein folding. The second part of the talk will be focused on the bottom-up design and construction of protocells, model microcompartments capable of rudimentary functions of living cells. I will introduce the use of coacervates as relevant protocellular models, and illustrate how light can be exploited to implement advanced behaviours in these self-assembled systems. I will finally show how these light-activated protocells can serve as a basis to generate dynamical behaviour in interacting protocell communities.