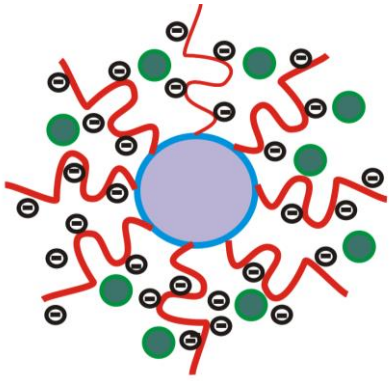
Functional Self-assembled Nanostructures from Block Copolymers and Proteins (NANOMACRO-ARISTEIA I)

The NANOMACRO project aims at advancing fundamental knowledge and demonstrating proof of concept in the design, properties and performance of novel, stimuli-responsive nanostructures formed by pairing block copolymers and proteins through non-covalent interactions. Electrostatic self-assembly and hydrophobic interactions are chosen as the driving forces for the preparation of the chimeric synthetic-biological nanostructures, since this has been proved so far to produce minimal effects on protein structure and bioactivity. Focus is placed on nanostructures based on the interaction between preformed block copolymers assemblies and protein molecules, which can result in the formation of hierarchical organized assemblies. pH, ionic strength and temperature responsiveness of chimeric nanostructures are stemming from the chemical design and the macromolecular architecture of the block copolymer component (diblock, triblock, selectively end functionalized block copolymers).

We aim at a detailed characterization of the formed nanostructures using a gamut of physicochemical techniques available to our group, as well as through existing collaborations and/or via the use of user facilities in international labs. This together with a thorough investigation on the factors that control interactions, structure formation and responsiveness (block copolymer architecture, molecular weight and composition, protein size, charge and conformation, physicochemical parameters of the systems - pH, ionic strength, temperature, concentration - and overall preparation protocols) should enable basic understanding and elucidation of relationships pertaining to building blocks characteristics/nanoassembly structure/functionality correlations and also provide effective fine-tuning of the nanostructures. Activities focusing on the evaluation of the properties of the nanostructures in respect to their utilization as nanocarriers/nanocontainers, nanotemplates/nanosupports for cell adsorption and tissue reconstruction/engineering and active components of (bio)sensors will make a first connection to potential applications of the developed macromolecular nanosystems.



Block copolymer micelles incorporating protein molecules (green) in their corona, through electrostatic interactions

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