IL4.3 Insights on the morphology and biological activity of gold nanoparticles protected by self-assembling mixtures of ligands

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The promise held by nanomaterials for diagnostic/therapeutic applications has greatly excited the entire scientific community.[1] Unfortunately, many hurdles including toxicity, immunogenicity, and decreased efficacy heavily hampered the use of nanoparticles (NPs) in bio-nanomedicine. Thus, a full understanding of NP ability to negotiate biological barriers will undoubtedly lead to an improved knowledge of their basic biology, enhanced control over their potential adverse effects, and ultimately the development of enriched classes of diagnostic/therapeutic agents.
Gold NPs (AuNPs) are ideal candidates to elucidate fundamental properties of biological interactions at the nano- and molecular-scale, particularly when protected with self-assembled monolayers (SAMs). When mixed SAMs of dislike molecules are used to coat AuNPs, nanoscale domains spontaneously form in the particle ligand shell. The formation of these 3D-patterns (typically patched, striped and Janus domains) provides AuNPs with surface dependent properties which, in turn, are expected to determine NP biological outcome.[2]
In this contribution we describe the first evidences of our investigation of the self-organization of mixtures of immiscible amphiphilic PEG-terminated fluorinated and hydrogenated ligands on the surface of AuNPs.[3] Studies of the morphology of these mixed monolayers were carried out experimentally by electron spin resonance (ESR) measurements; concomitantly, an *in silico* approach based on multiscale molecular simulations in explicit water was used to predict the microphase segregation morphology of the ligands on the metal surface at molecular level. Then, again combining theory and surface plasmon resonance (SPR) experiments on model membranes as well as *in vitro* experiments, we investigated the role of ligand arrangement and composition on the interaction with lipid bilayer and on cellular toxicity and uptake of these monolayer protected NPs.

The Italian Ministry of University Research (MIUR) through the Scientific Independence of Young Researchers (SIR) project “Structure and FunctiOn at the Nanoparticle bioInterfAce” (grant RBSI14PBC6) supports these activities.

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