# Exploring and exploiting nano-bio interfaces: a physico-chemical perspective

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When man-made nanomaterials are put in contact with living organisms, either intentionally or in a fortuitous way, their interaction with biomacromolacules and biological barriers will determine their bioactivity, biological fate and cytotoxicity. Therefore, understanding the interaction of nanoparticles with biological interfaces is vital to fill the gap between design/synthesis/engineering of nanomaterials and their full translation into end-use applications.
Lipid self-assemblies, such as planar bilayer membranes, have the central stage among biological barriers: for any engineered nanomaterials to reach an intracellular target or to display cytotoxicity, a cell membrane should be crossed. In recent years lipid-based synthetic membranes have been extensively proposed to mimic natural membranes, under highly controlled and simplified conditions with the aim to identify the key determinants of nano-bio interactions.
In this lecture, we will revise our current knowledge about relevant phenomena at the nano-bio interfaces, with particular emphasis on the importance of lipids and of their self-assembled structures. Different mimics of biological membranes, nanomaterials and investigation techniques/strategies will be considered. Starting from simple biomimetic interfaces, studies on biological barriers with increasing complexity will be shown, from non-lamellar phases to biogenic membranes. We will show how variable degrees of complexity of the lipid-based membrane emphasize diverse specific features of nano-bio interactions. We will highlight how the experimental evidences on nano-bio interactions can be framed in a physicochemical perspective, in terms of non-specific forces. Finally, we will showcase some recent case studies, where this fundamental understanding on nano-bio interfaces is exploited for applicative purposes, specifically the characterization of biogenic extracellular vesicles.