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Nanoparticles interactions with the biological environment: favorable and inconvenient interplays

Nanoparticles (NPs), with their extraordinary physical-chemical and biological properties, hold a grand promise for a medical revolution in diagnostics and therapeutics. Nevertheless, nanomedicine development is substantially hampered by some fundamental critical issues concerning the control over the nanomaterial features and their biological identity, which are still often overlooked and challenging to overcome. Thus, several steps are needed to meet regulatory agency requirements and improve the in vitro-to-in vivo translation, which is currently falling short. When nanomaterials get in contact with biological fluids (i.e., blood, plasma, serum, saliva, urine), the

biomolecules in the media immediately start interacting with them, adsorbing onto their surface and coating previously prepared functionalities, thus providing a new biological identity (and new surface chemistry). This coating, called biomolecular corona, defines the NP interactions and their final biological fate. It is becoming more and more clear that to make those steps concrete, in addition to how NPs can affect biology, it is necessary to analyze how the biological environment and machinery can impact the NPs identity.

In this seminar, the potential of inorganic nanoshapes, nanozymes, and innovative biomimetic approaches will be discussed, introducing some promising strategies to exploit bio-coatings and highlighting the role of physical-chemical, and biological surfaces of different nanomaterials employed in a variety of different contexts, including colorimetric diagnostic kits, antioxidant therapy, and nano-vaccines strategies. This work sets the solid basis for the future translation of these nanoformulations into clinical settings.

Dr. Luca Boselli obtained his M.Sc. in Photochemistry and Material Chemistry in 2011 from the University of Bologna. In 2014, he obtained his PhD in organometallic chemistry at the Laboratoire de Chimie de Coordination (LCC-CNRS) in Toulouse. From 2015 to 2019, he joined the Centre for BioNano Interactions (CBNI) – University College Dublin, as a Postdoctoral Fellow. During this period, he worked on the synthesis of nanoparticles (with different compositions, sizes, shapes, and surface chemistry), biomimetic systems, and the investigation of their behavior in the biological environment (i.e., understanding the bionano-interface and how it might influence/direct biological outcomes as targeting, toxicity, cell uptake, biodistribution, immune response). He is currently a Researcher at the Italian Institute of Technology (NanoBD Lab), where his main scientific activities involve the development of innovative biomimetic nanosystems with plasmonic and enzyme-like properties (nanozymes) for therapeutic and diagnostic applications

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Ospite: Prof. Paolo Bergese