Title: Nanozymes As Multifunctional Tools Against Neurodegenerative Loops

Abstract:
Oxidative stress contributes to the progression of neural disorders in the central nervous system (CNS). Alzheimer's disease, Parkinson's disease, and age-related macular degeneration (AMD) have been associated with antioxidant enzymes depletion/dysregulation. Unfortunately, currently, there is no cure for most of the neurodegenerations, and antioxidant molecular drugs under investigation in this context were mostly inadequate in mitigating noxious ROS. Nanozymes (enzyme-mimicking nanoparticles) have recently attracted increasing attention as potential future therapeutics. Nanozymes can act similarly to natural enzymes (i.e., superoxide dismutase and catalase) but are associated with lower costs, easy large-scale production, and higher stability/durability. Given the complexity in understanding the nanozymes catalytic behavior, precise metrology is crucial to fully exploiting these new nanodrugs. In this framework, we analyzed the oxidoreductase-like activities of a series of different nanozymes (platinum, palladium, gold, ceria, and iron-oxide NPs), and the best-performing one (PtNP) was investigated for its ROS-scavenging therapeutic potential in vitro and in vivo. We analyzed how the evolving biological environments can modulate the nanozyme's properties during its journey from the bloodstream to the intracellular compartments, showing that biomolecular corona (a layer of proteins adsorbing onto the NPs surface in biological fluids), temperature, and pH, are involved in their biological behavior. We observed a convenient bio-nano interplay leading to an on-demand nanozyme-mediated ROS-scavenging, able to maintain physiological homeostasis during oxidative stress in the CNS cellular components. In vivo experiments in an AMD mouse model confirmed our therapeutic candidate's therapeutic potential, highlighting intriguing anti-inflammatory properties.

Short bio:
Dr. Luca Boselli obtained his M.Sc. in Photochemistry and Materials Chemistry in 2011 from the University of Bologna. In 2014, he earned his Ph.D. in Organometallic Chemistry from the Laboratoire de Chimie de Coordination (LCC-CNRS) in Toulouse. He subsequently joined the Centre for BioNano Interactions (CBNI) at University College Dublin as a Postdoctoral Fellow, a position he held until 2019. In the same year, he moved to Genoa, Italy, where he currently holds a Researcher position at the Nanobiointeractions & Nanodiagnostics Laboratory of the Italian Institute of Technology. His research focuses on the design and development of innovative biomimetic nanosystems with plasmonic and enzyme-like properties for therapeutic and diagnostic applications..