

Bio:

Florent Barbault is a Senior Associate Professor at Université Paris Cité, specializing in theoretical chemistry. He earned his PhD in structural biology in 2001, worked in the pharmaceutical industry, and completed a European postdoctoral fellowship before joining the ITODYS laboratory, in University Paris Cité, where he now leads the Theoretical Chemistry and Modelling team.

His research focuses on molecular modelling of complex biological systems and on biomolecule–nanomaterial interfaces, with applications in health and biomaterials. He co-authored a patent linked to a drug currently commercialisation, has published over 70 articles, and is active in international collaborations. He has held academic leadership roles, serves as an expert evaluator, supervised 16 PhD theses, and coordinated or contributed to around thirty funded national and international projects.

Abstract:**Simulating Copper Nanoclusters to Restore Brain Copper in Menkes Disease**

Menkes disease results from the loss of ATP7A function, which sequesters dietary copper in peripheral tissues and deprives the brain. To date, the prevailing treatment for this genetic disorder is copper supplementation, although copper poorly crosses the blood–brain barrier (BBB).

In this context, a histidine/ascorbate-capped copper nanocluster (CuNC@HisAsc) has been designed as a potential vector for copper delivery to the brain. However, the chemical characterization and biological evaluation of such inorganic complexes are difficult to achieve experimentally. Therefore, molecular modelling studies, ranging from quantum mechanics (QM) calculations to molecular dynamics (MD) simulations of the BBB membrane, have been performed to understand and further optimize these systems.

Both experimental and theoretical studies demonstrate that CuNC@HisAsc is a credible copper vector that robustly anchors at the BBB interface and modulates local mechanics, yet does not cross the membrane on the microsecond timescale. Altogether, these results underscore the potential of nanocluster-based copper delivery and demonstrate the unique contribution of molecular modelling in guiding innovative therapeutic strategies for Menkes disease.