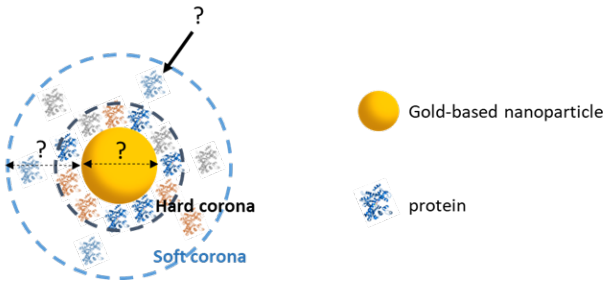
Development of new analytical methods for studying the behavior of gold nanoparticles in biological media



Context :

Gold nanoparticles (NPs) appear very promising for applications in nanomedicine, especially for therapeutic approaches by photothermia. However, one of the major obstacles for going into the clinic is the lack of methods allowing their characterization in vivo. Indeed, in the complex environment of a living organism, proteins and other biomolecules present in the biological fluids spontaneously form an adsorption layer on the surface of the nanoparticles, called the protein corona. This protein layer will then govern the internalization, the biodistribution and thereby the toxicity of the nanoparticles.

We have recently shown that Taylor dispersion analysis (TDA) coupled with ICP-MS allows the measurement of hydrodynamic radii of nanoparticles containing metals, in conditions where both scanning electron microscopy (SEM) or dynamic light scattering (DLS) turn out to be ineffective.[1,2]

Objectives of the PhD:

The goal of the project is to study the behavior of a series of gold NPs in biological media. New analytical methods developed on the basis of the TDA-ICP-MS coupling will aim at:

- measuring the size of these nanoparticles in various media,
- measuring the protein corona in media containing known proteins or in more complex samples such as serum and defining the reversible/irreversible character of the interactions,
- quantifying the adsorbed proteins, by taking advantage of both the multi-elemental feature of ICP/MS and the affinity of proteins for metals (e.g. albumin/Cu, transferrin/Fe, fetuin/U) or proteins labeling with metallic tags.

This new analytical tool will contribute to an in-depth understanding of the interaction between NPs and proteins, a decisive factor in the biological response of organisms to NPs exposure.

[1]Lucie Labied, Paul Rocchi, Tristan Doussineau, Jérôme Randon, Olivier Tillement, François Lux, Agnès Hagège, Anal. Chem., 2021, 93, 1254-1259

[2]Lucie Labied, Paul Rocchi, Tristan Doussineau, Jérôme Randon, Olivier Tillement, Hervé Cottet, François Lux, Agnès Hagège, Anal. Chim. Acta, 2021, 1185, 339081

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Proposed collaboration within ArchiFun network (not mandatory at this stage):

Proposed list of secondments (not mandatory, but recommended if known already):

Main ArchiFun theme involved:

Host-pathogen interactions;

Mechanisms of bacterial resistance and cancer onsets;

Neurodegenerative and autoimmune diseases;

Translational research in prevalent diseases;

Physiology and ecology;

Neurosciences and cognition.