

## LINKING STRUCTURE AND PROPERTIES IN MONO- AND BI-METALLIC CLUSTERS AND NANOPARTICLES

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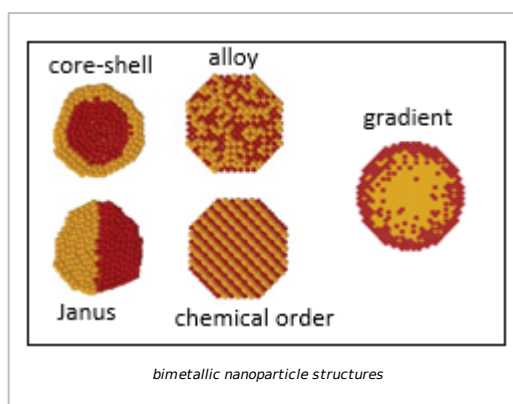
### SCIENTIFIC CONTEXT :

Correlating the atomic and chemical structure of metal clusters and nanoparticles to their electronic properties is central to the fundamental understanding of nanostructured materials. This PhD addresses this correlation in two closely related contexts:

1) Bimetallic nanoparticles are widely used in various applications such as catalysis and their physico-chemical properties strongly depend on the chemical configuration, i.e., on whether the metals alloy or segregate. In most cases it is unknown which chemical order is adopted in the ground state and how it changes upon exposure to reactive conditions (oxidizing, reducing).

2) For small clusters (smaller than 100 atoms), the role of the cluster surface and the detailed chemistry at its interface with a given environment has to be taken into account with atomic precision. The way how localized chemical bonds between a metal cluster and an oxide environment or reactive molecules impact its electronic structure is unclear and constitutes a real challenge for both experiment and theory.

The goal of this PhD project is to investigate these topics by combining optical spectroscopy with Transmission electron Microscopy (TEM) and derived spectroscopic techniques. The clusters in question (Ag, Au, alloys such as AuPd or NiAg) all have surface plasmon resonances, which are used as a fingerprint of the particle's electronic structure. Notably the dependence of the plasmon resonance on environmental conditions gives important insight.



### MISSIONS :

The PhD candidate will fabricate metal clusters and nanoparticles using physical techniques. Metal cluster sources based on magnetron sputtering or laser vaporization, followed by gas aggregation and mass selection in the gas phase permit generating highly defined nanostructured samples. The nanoparticles are then investigated by TEM and by optical spectroscopy of the surface plasmon resonance, in-situ and under environmental conditions. The obtained results are compared to complementary experiments and theoretical simulations, all provided within the scientific projects and collaborations.

The candidate should hold a degree in physics or physical chemistry, prior experience in nanoscience, Transmission electron Microscopy or optical spectroscopy is an advantage.

### OUTLOOKS :

Thesis funded by one ANR project (GNOME) and one PEPR DIADEM project (NACRE)

### BIBLIOGRAPHY :

<https://www.pepr-diadem.fr/projet/nacre/>

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