Hierarchical structuration of nanoparticle assemblies for magneto-plasmonic sensor

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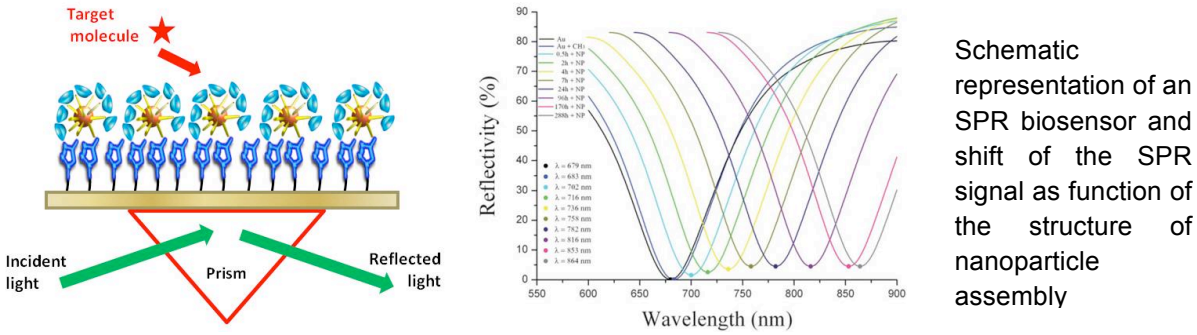
Owing to their tunable collective properties, nanoparticle arrays have become a powerful platform for the development of new and highly sensitive biosensors. However, the development of such nanodevices still suffers from a lack of control on the structure of nanoparticles assemblies.

In this thesis we will explore a new way to prepare multi-nanoparticle assemblies with highly-defined structures and tuneable collective properties. The approach will be based on molecular interactions between specific functional groups at the surface of nanoparticles and self-assembled monolayers (SAMs) of organic molecules grafted on a gold substrate. The innovation will consist in the combination of “click chemistry” and molecular recognition which will enable to build assemblies of two different types of nanoparticles. These assemblies will be build by addressing the surface functionality of SAMs with different functional groups or by the alternative deposition of nanoparticles bearing complementary functional groups.



Schematic representation of an SPR biosensor and shift of the SPR signal as function of the structure of nanoparticle assembly

This project is a collaboration with several partners (L. Jierry, ICS and X. Cattoën, Insitut Néel à Grenoble). It wil be based on our recent work which demonstrated the efficency of click chemistry to tune the magnetic collective properties of iron oxide assemblies [1] [2] and on the modulation of the SPR signal as function of the structure of nanoparticle assemblies.[3] Now we want to extend these studies to assemblies containing magnetic and plasmonic nanoparticles. The combination of both types of nanoparticles is expected to induce new magneto-plasmonic collective properties in order to prepare highly sensitive biosensors. The detection of target molecules will be driven by biofucntional groups at the surface of nanoparticles and will result in the modulation of the magneto-plasmonic properties. An extension could be to investigate the ability of these assemblies as magneto-resistive sensors as function of the dimensionality and the number of nanoparticles.

[1] D. Toulemon, B. P. Pichon, X. Cattoen, M. Wong Chi Man, S. Begin-Colin, Chem. Commun., **47**, 11954 (2011),
[2] D. Toulemon, B. P. Pichon, C. Leuvrey, S. Zafeiratos, V. Papaefthimiou, X. Cattoën, S. Bégin-Colin, Chem. Mater., 25n 2849 (2013).
[3] B. P. Pichon, G. Barbillon, P. Marie, M. Pauly, S. Begin-Colin, Nanoscale, 3, 4696 (2011).