Design of original a bio sensor based on SPR nanostructured metal thin films

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Detection of traces of environmental pollutants, warfare chemicals, pathogens in food and biomarkers for disease diagnosis is contemporary challenge of our society. Indeed next generation of sensors will have to be highly efficient and to fulfil requirements such as high sensitivity, high specificity, easiness, durability and rapidity to process. In this context, this project aims at tailoring a new type sensor based on nanoparticle assemblies. This approach consists in modulating the surface resonance plasmon (SPR) properties of gold gold thin films by nanostructuring iron oxide nanoparticle assemblies on their surfaces.[1] Such nanoparticles with high refractive index enable to modulate significantly the SPR signal of the gold thin film by small variations in the structure of the assembly (density, packing, organization, nanoparticle size and morphology, number of layer, etc.). [2,3] Therefore, the SPR signal will be set at a precise wavelength to enhance the sensitivity. Additional nanoparticles may be used to enhance the detection of target molecules by taking advantage of local SPR properties.

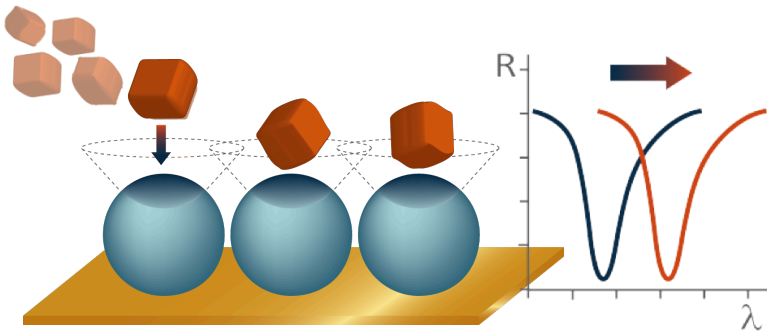

Figure 1 : Adsorption of biomolecules onto iron oxide nanoparticles assembled onto a gold thin film and the corresponding shift of SPR signal.

Models of receptor molecules will be grafted at the surface of nanoparticle assemblies and will consist in imminosugar functions which are commonly used as enzyme inhibitors.[4] Multivalent interactions are well-known to remarkably enhance the affinity of a wide range of target molecules through specific molecular recognition, i.e. to significantly low down the limit of detection.The amount of target molecules adsorbed on nanoparticle assemblies will be quantified according to the shift of the SPR signal. Such hierachical structures will be built-up by a new and innovating approach which has been reported recently for nanoparticle assembling by our rearch team : the copper catalyzed azido-alkyne cycloaddition (CuAAC) “click” reaction. This research project will require many characterization techniques dedicated to nanoparticles (XRD, TEM, IR, DLS …), to surfaces (XPS, PM-IRRAS …) and to absorption kinetics (SPR) through ongoing collaborations with laboratories of CNRS and Unistra.

[1] M. Dolci, B. P. Pichon et al. J. Mater. Chem., **6**, 9102 (2018).
[2] M. Dolci, B. P. Pichon et al. Appl. Surf. Sci. **527**, 146773 (2020).
[3] P. Berling, B. P. Pichon et al. Sensors & Diag. **1**, 1069 (2022).
[4] Compain, P. et al. ChemBioChem **15**, 1239 (214).