Modeling a Surface Plasmon Resonance and Surface Enhanced Raman Scattering nanosensor for environmental applications.

In charge of the project: Chantal Compère and Florent Colas
Contact: Florent Colas (florent.colas@ifremer.fr) Duration: 18 months
Application deadline: the 30th December 2016

For the last decades, the seas and the oceans have become of first ecological and socio-economical interests. The detection and assay of traces of chemicals is the keystone of many oceanographic issues. Most of the time, the measurements are carried out in laboratory on natural samples. This approach provides accurate and quantitative data but suffers from limitations: sampling error, long response time, low temporal and spatial resolution, and poor cost efficiency. *In situ* instruments are then being currently developed to reduce these drawbacks and perform fast, accurate, quantitative and robust measurements.

Since the 90s, Surface Plasmon Resonance (SPR) biosensors have spread in many areas for the quantitative assay of many kinds of target such as micro-organism, chemicals, biomolecules… Recently an *in situ* SPR biosensor was demonstrated capable for assaying a biotoxin at concentration as small as few tens of ppb [1]. Surface Enhanced Raman Scattering (SERS) spectroscopy is capable of specifically detecting traces of molecules *in situ* in many different applications [2].
The SPR and the SERS sensors are intrinsically complementary. Both techniques are fast, sensitive and label-free. The former is quantitative but might suffer from specificity while the latter is very specific but is not always quantitative. The objective of this project is to combine these two techniques to develop a quantitative, fast, specific and sensitive sensor.

The post-doc will design the sensor that will consist of arrays of gold nanoparticles for a specific and quantitative detection by Surface enhanced Raman scattering techniques and Localized Surface Plasmon Resonance at the same time. This project will rely on numerical modeling. Two axes of optimizations will be studied: the arrangement of nanoparticles and their individual geometry. A functionalization layer, whose aim is to concentrate the molecule close to the nanostructures will be modeled. The work will include optimizing the thickness of the layer for a rapid diffusion of molecules to the nanoparticles while ensuring maximum signal. The metrological performances of functionalized sensor layer will then predicted numerically.

Applications:
The candidate should have a strong background in optics and particularly plasmonic modeling.
The post-doc is funded by Ifremer and the Brittany Region. The funding is part of the strategy program SAD (Stratégie d'Attractivité Durable), whose aim is to attract researchers with a strong international background. The grant can be awarded to foreigners or French researcher having spent at least 1 year over the last three years in a foreign country.

The applicant should provide by e-mail to florent.colas@ifremer.fr :

- a cover letter,
- a curriculum vitae,
- two reference letters

[1] Colas F. , M.-P. Crassous, S. Laurent, W. Litaker, E. Rinnert, E. Le Gall, M. Lunven ,L. Delauney and C. Compère (2016). Limnology and Oceanography: Methods, 14(7), 456-465.
[2] Péron O., E. Rinnert, F. Colas, M. Lehaitre, C. Compère (2010) Applied Spectroscopy, 64 (10), 1086-1093