In-situ SERS technique for real-time monitoring of a plasma process for treating arsenic-contaminated water

Background

Over the last decade, there has been significant growth in the use of high-voltage discharges in liquids, and more particularly in water, for environmental applications such as depollution, or processes for nanomaterials synthesis, while consuming fewer chemical solvents.

Among the many pollutants that can be present in water, some are known carcinogens, such as inorganic arsenic (As). Various processes can be used to eliminate or reduce As in water, but require prior oxidation of the As(III) to As(V) (using chlorine as an oxidising agent, for example). In order to limit the chemicals used to oxidise heavy metals, treatment processes using plasmas generated in a liquid medium (PLI) are of great interest. The oxidation of As(III) using PLI processes is therefore part of an eco-efficient approach that saves energy and limits the production of potentially polluting waste.

Strict standards for water quality have been defined in line with the World Health Organisation's guide values (10µg.L^{-1} in As). Numerous techniques are available for the effective determination of trace arsenic, but they require extensive equipment and are time-consuming. In addition, they cannot be used to monitor concentrations in real time. Surface Enhanced Raman Spectroscopy (SERS) could overcome these drawbacks. Preliminary results have already been obtained, showing the benefits of using silver nanoparticles to detect AS(III) in water.

Purposes

The main objective of the internship is to study the implementation of the SERS technique for real-time monitoring of As(III) oxidation by the PLI process, making it possible to assess the feasibility of the process without having to resort to *ex-situ* analyses, which are costly in terms of investment, time and personnel.

This essentially experimental work will focus on the following objectives:

1. The first part of the internship will be to confirm the preliminary results obtained on nanostructured gold and silver surfaces and to produce a calibration curve for these SERS sensors.
2. The second part of the internship will be dedicated to the use of the SERS detection technique for the in situ analysis of As(III) during its oxidation by PLI.

Skills

The person recruited should have a genuine interest in experimental work, as well as a strong scientific curiosity and rigour.

Oral and written communication skills in English are mandatory.

Techniques used

Raman Spectroscopy ; Surface functionalisation ; liquid phase plasma.

Details

Please send a CV, a covering letter and a letter of recommendation from someone who has supervised you on an internship or as part of your training by email.

Place of work

Laboratoire LSPM UPR CNRS 3407

99 avenue Jean Baptiste Clément

93430 Villetaneuse

Duration

4-5 months from the end of March 2024

Supervisors :

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