The **French-German Research Institute of Saint-Louis (ISL)** situated in the border triangle of Germany, France and Switzerland is an internationally renowned research institute belonging to a global industrial and economic network.
The spectrum of our core activities comprises a variety of topics: aerodynamics, energetic and advanced materials, lasers and electromagnetic technologies, protection, security and situational awareness. Our activities are related to both basic and applied research.

ISL is offering a **PhD Position**

Research field: Energetic materials et systems

Detecting organophosphorous simulants with SEIRA

Nowadays, the risk of being exposed to chemical warfare agents like Sarin, Tabun, mustard gas or VX is growing. In these times of growing threats, an efficient protection of military forces in overseas missions and of civilians becomes a necessity and is thus a key interest for our defence sector. It is for this reason that the creation of a sensible, selective and easy to incorporate sensor is necessary and urgent. However, this step is a major challenge. As of yet, no system is capable to meet all of these requirements.

The goal of this doctoral thesis will be to develop nano-antennas consisting of semiconductors (InAs and GaSb) for surface-enhanced infrared absorption (SEIRA) and to show their sensibility and selectivity for the detection of gases like organophosphorous simulants and/or explosives.

At first, there will be a theoretic study via a data processing simulation (methods of calculation (FDTD and RCWA)) to determine the electromagnetic field enhancement due to the plasmonic effect of semi-conductors nanoantennas (composed of InAs and GaSb)."
Afterwards, these antennas will be produced in the clean room using different methods (optical and electronic lithography, physical and chemical attacks and chemical preparation of the surfaces with a self-assembled monolayer)."
Then, they will be evaluated before testing their reactivity towards the other compounds. The data obtained during the experiment will be compared to the theoretical results. During the second phase, the goal will be to achieve a surface functionalisation with bifunctional organic molecules.

This step is necessary to optimize the sensor's selectivity and sensitivity. In order to ensure this, the candidate can rely on already existing collaborations. In the end, tests will be conducted to determine the sensor's detection limits. During the development stages of the sensor, different characterisation techniques (Raman, IR, UV, SEM, AFM, etc.) will be used for its evaluation.

This doctoral thesis will be part of a collaboration between the lab working with nanomaterials for systems under extreme stress (NS3E) run by the French-German Research Institute of Saint-Louis (ISL) and the University of Montpellier Institute for electronics and systems (IES). The candidate's work will mostly take place at the IES.

Candidate profile

The candidate must be able to work in a multidisciplinary environment and should be motivated, diligent and precise.
The candidate should be prepared to travel on numerous occasions between the IES and the ISL.

Reference
[1] F. BARHO et al., Nanophotonics 2018, 1, 507
[2] F. BARHO et al., ACS Photonics 2019, 6, 1506
[3] T. TALIERCIO, P. BIAGIONI, Nanophotonics 2019, 8, 949
[4] F. NEUBRECH et al., Chem. Rev. 2017, 117, 5110
[5] E. BRUNOL et al., Sensors and Actuators B 2006, 120, 35
[6] D. SPITZER et al., Angewandte Chemie International Edition 2012, 51, 5334

This PhD will begin in October, 2020.

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