PhD in analytical chemistry

Development of an online analytical system to measure the oxidative potential in particles from ambient air and working spaces.

The department "Sciences de l'Atmosphère et Génie de l'Environnement" (SAGE) of Mines Douai (http://sage.imt-lille-douai.fr) pursue environmental research activities linked to Air Quality and impact of anthropogenic emissions on the physico-chemical characteristics of indoor and outdoor atmosphere. Its research project relies on fundamental and applied researches in atmospheric science in order to better understand physico-chemical processes of production, transport and transformation of gaseous and particulate pollutants.

The « laboratoire d'Analyse Inorganique et de Caractérisation des Aérosols » (LAICA) of « Institut National de Recherche et de Sécurité » (INRS – www.inrs.fr) has for main mission to evaluate the occupational exposure to certain inorganic aerosols (metals, acids, fibers, silica) in working space environments. To do so, the laboratory has strong study and research activities to improve pollutants measurement methodologies and it participates to sampling campaigns, develops capacity trials and brings expertise to various standardization bodies (AFNOR, Anses, Cofrac)

Context and project description:

Atmospheric suspended particles once inhaled may induce health problems like inflammation of the respiratory tract or severe respiratory or cardiovascular pathologies linked to carcinogenic effects (group 1, IARC). Exposure to atmospheric particles may induce oxidative stress at the pulmonary cellular level, due to abnormal accumulation of reactive oxygen species (ROS) in the lungs. Some particles, in ambient air or in working atmosphere, contain high level of transition metals (Fe, Cu …) known to catalyze the ROS production such as hydroxyl radicals. The ROS production capacity may be estimated by non cellular tests combining airborne particles collected on filters and various reactants capable to quantify the production of free radicals. These laboratory trials are time consuming and difficult to perform. Moreover, they are generally badly representing the actual pulmonary physiological conditions. In addition, particles come from various origins, may evolve in the atmosphere and may be dispersed or transported depending on the meteorological conditions, inducing an extreme variability of the particle chemical composition. It is thus important to determine the oxidative potential (OP) of these particles *in situ* with a high frequency (hourly) while mimicking as close as possible the human respiratory physiological conditions of the ROS production.

In collaboration with the INRS, we propose to develop an on-line oxidative potential measurement protocol simulating the lung physiological characteristics.

① After a thorough review of the literature on the OP's measurement techniques, several tests previously published will be selected for comparisons depending of their on-line potential applicability.

② The methodology will be developed on metal-reach particle samples (ex : welding fume) as well as ambient airborne particles from an urban environment (traffic sources). An experimental set-up will be produce in order to compare filtered or bulk particle samples, allowing to study the operating conditions for different metal concentrations corresponding to outdoor ambient air as well as working spaces. Other parameters influencing the methodology results will be investigated as well (particle size, aggregation, metal dissolution, organic and elemental carbon interactions, stability of the samples…).

Then, *in vitro* cellular assays simulating the pulmonary physiological conditions will be developed for comparison with the non cellular test pre-selected. Measurements of inflammatory mediators (ex. cytokines) and other biomarkers of the oxidative stress exposure (ex. glutathione) on reference particles will allow validating/interpreting the selected tests. The best methodology in terms of origin of particles, level of metal concentrations and physiological representativeness will be chosen for the on-line measurement strategy.

③ An aerosol sampling device combining discrete chemical reactions and on-line measurements of the oxidative potential will be developed. Its efficiency will be tested (1) on standard reference material of known chemical composition then (2) directly on site (outdoor air and working spaces). During on-site measurements, samples will be collected on filters for comparison and validation of the on-line methodology. Various characteristics (reliability, autonomy, sturdiness) of the on-line instrument will be assessed during field campaigns.

PhD in analytical chemistry

Development of an online analytical system to measure the oxidative potential in particles from ambient air and working spaces.

Key-words: Oxidative potential, Atmospheric particles, Metals, Ambient air, Working atmosphere,

Candidate profile:
The candidate has successfully obtained a Master 2 degree in analytical, environmental or atmospheric chemistry or biochemistry. A good level in French or English is required. A driving license is helpful.

Hosting laboratories :

SAGE, Mines Douai, 59508 Douai, France

LAICA, INRS, Vandœuvre-lès-Nancy, France

Thesis director: Pr. P. Coddeville

Thesis supervisors: L. Alleman, E. Perdrix, D. Rousset

Doctoral school: SMRE, University of Lille

Financial support: ~1550 € net / month over 3 years.

Location and starting date: The PhD thesis will take place at the department SAGE (Mines Douai) and at the LAICA laboratory (INRS, Vandœuvre-lès-Nancy).

The PhD will starts in October 1rst, 2018

Contact: Send a curriculum vitae, a companion letter, the Master degree grades and 2 recommendation letters to:

Laurent ALLEMAN/Esperanza PERDRIX IMT Lille Douai Sciences de l'Atmosphère et Génie de l'Environnement 941 Rue Charles BOURSEUL CS 10838, 59508 DOUAI Cédex France Email : laurent.alleman@imt-lille-douai.fr	Davy ROUSSET INRS MP/LAICA 1 Rue du Morvan, CS 60027, 54519 Vandœuvre-lès-Nancy Cedex Email : davy.rousset@inrs.fr