

Master 2 level traineeship proposal

New anti-viral photothermal therapies based on transition metal nitride nanoparticles

Period of traineeship: January - July 2022

Laboratory: *Laboratoire Lorrain de Chimie Moléculaire (L2CM)*, Nancy, France

Background: Viral epidemics have marked modern history with the epidemics of smallpox, Spanish influenza, HIV and more recently SARS-CoV-2. Vaccines, one of the universal approaches to epidemics, have the disadvantage of a long development time (at least 18 months), with possible viral variants escape from the generated immune response. The absence of specific antiviral curative treatments underlines even more the need of **new therapeutic antiviral approaches**. The project developed in L2CM, in close collaboration with the Jean Lamour Institute (Nancy, France), proposes the implementation of a new **phototherapy** approach in viral infections. The strategy is based on the creation of **nanoparticles of transition metal nitrides (TMN)**, penetrating into infected cells. The internalized nanoparticles will then be photoactivated using infrared radiation (low energy and non-ionizing) to obtain a **photothermal effect** inducing programmed cell death in the cell infected by the virus.

Objectives of the internship: The subject of the internship on the study of the cytotoxicity of TMNs, according to their size, dispersion and concentration, on cells not infected by the virus, and the determination of their impact on blood cells of the host, as well as on the immune response. Following the assessment of the biocompatibility of the TMNs, these will be evaluated for their effect on virions and on cells infected with model viruses, such as the human coronaviruses HCoV 229E (alpha CoV) and HCoV OC43 (beta CoV). This analysis will be also carried out following exposure of TMN-treated cells to irradiation with near infrared rays (NIR).

Methodology: The candidate will carry out the evaluation of the antiviral properties (human coronavirus, HCoV 229E/ HCoV OC43) of TMNs, as well as the evaluation of their impact on the host cells (cytotoxicity, hematotoxicity). The activity of TMNs will also be evaluated in the presence of irradiation in the NIR. The link with photo-physical (photothermal) and physico-chemical properties will be analyzed in collaboration with Jean Lamour Institute.

Profile sought: The candidate must have solid knowledge in virology and cell culture. She/he must have the necessary knowledge for analyzes in cell biology (light microscopy, immunofluorescence, FACS, Western blot), molecular biology (PCR, RT-PCR) and biochemistry. Good knowledge of electron microscopy and initial experience in handling pathogens under biosafety level 2 (BSL2) laboratory conditions will be welcome. For international applicants, fluency in English is sufficient (a good foundation in French will be appreciated).

Application: Applications should be sent to Mihayl Varbanov (mihayl.varbanov@univ-lorraine.fr) and must include a CV, cover letter and the transcript of record of BSc and MSc levels.