French-Australian Co-Tutelle PhD position

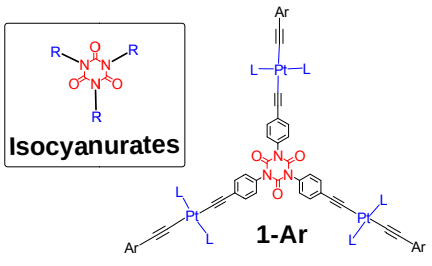
Luminescent two-photon absorbers made from Platinum-alkynyl complexes for Optical Limiting and more…

Place(s) of work:
• Institut des Sciences Chimiques de Rennes ISCR – UMR 6226, Université de Rennes 1
• Research School of Chemistry, Australian National University, Canberra (Australia)

Keywords:
Multi-step synthesis, Coordination chemistry, Molecular photonics, Multiphotonic absorbers, Molecules and Materials for optics

Context:
Since their (re-)discovery in late 80s, two-photon absorbers have generated a tremendous amount of applications in various societal domains such as for instance microfabrication, materials for optics (waveguides, optical gates, limiters, redressors, etc…) or bio-imaging and curing.[1] We have previously shown that triarylisocyanurates have a promising potential as organic two-photon absorbers and also, that in presence of transition metal atoms, their nonlinear optical (NLO) properties (including two-photon absorption) are strongly enhanced.[2,3] We now wish to evolve toward more applied prospects (ANR project obtained).

Project description:
The thesis project focuses on the development of two-photon organometallic absorbers, consisting of platinum (II) luminescent complexes. Other metals may be considered later, depending on the evolution of the subject. It can be adapted to the candidate's (organic / organometallic) profile. The goal is to develop new molecules that can have applications in optical limiting, molecular imaging or even theranostics.[4] The subject will start with the synthesis and study of organometallic assemblies built around the isocyanurate core (such as **1-Ar** below), which are an old but poorly explored class of derivatives in optics,[5,6] and then, depending on the first results obtained, might soon evolve toward less closely-related analogues.



Examples of molecular materials made for optical limiting

[1] G. S. He *et al.*, Q. Zheng, P. N. Prasad, Chem. Rev. 2008, 1
[2] G. Grelaud *et al.*, *J. Organomet. Chem.*, *751* (2014) 181.
[3] A. Trujillo *et al.*, *Dalton Trans.*, *41* (2012) 7454.
[4] D. Yao et *al.*, *Chem. Eur. J.*, *23* (2017) 2635.
[5] G. Argouarch *et al.*, *Chem. Eur. J.*, *18* (2012) 11811.
[6] A. Triadon *et al.*, *New J. Chem.*, *42* (2018) 11289.

Collaborations:
• **Frédéric Paul** and **Olivier Mongin** (ISCR, France), organometallic and organic synthetic chemists (experienced in the design of two-photon molecular absorbers).
• **Abdou Boucekkine** (ISCR, France), DFT modeling of optical properties of molecules.
• **Mark Humphrey** (ANU, Australia), organometallic chemist experienced in the design of carbon-rich organometallics with large third-order nonlinear optical properties.

The Australian National University (ANU), located in Canberra, is the most famous university of Australia. This thesis co-tutelle project, while allowing the candidate to obtain a double PhD diploma, Australian (ANU) and French (UR1), will also allow him to get acquainted with the Australian culture and to perfect his practice of English.

Context:
This co-tutelle implies that the candidate will spend between one year and eigtheen months in Australia (ANU, co-funding 50%) and the remaining of the Time at UR1. He / She must therefore be autonomous in English and interested in gaining an international experience. Both at UR1 and at ANU, the PhD will be done in international teams of young PhD students. Most of the lab work will be concerned with chemical synthesis, but the French and Australian labs are also fully equipped for characterization of the linear optical properties of molecules (i.e. absorption and emission) and a clean room equipped for characterization of the NLO properties is also available at ANU.
For more info on the Australian partner group of M.G. Humphrey, see: http://chemistry.anu.edu.au/research/groups/organometallic-chemistry-molecular-materials

Profile of the applicant:
The applicant should be mainly interested by multi-step organic and organometallic synthesis and also, from a more fundamental standpoint, should be interested in improving his knowledge on the factors determining the optical properties of molecules (fluorescence, color, etc). In this respect, he will be involved in simple photophysical (luminescence, absorption) and electrochemical (cyclic voltammetry) studies. Skills in these fields will therefore be appreciated but are not required. In case of interest, he can also be associated to more involved (NLO) measurements at ANU. Finally, the student should be able to adapt to teamwork and be ready to spend some time in Australia. In that respect, the candidate will have to justify of a minimum score at the TOEFL (or IELTS) English test and have obtained good marks in M2 (≥ mention AB), as required for his/her registration at ANU.

Contact:
Interested candidates should contact F. Paul (frederic.paul@univ-rennes1.fr) or O. Mongin (olivier.mongin@univ-rennes1.fr) and send a CV.