

Development of earth-abundant metal catalysts for challenging oxidations of alkenes at the industrial stage

Offer type: post-doctoral fellowship

Financing: ANR LabCom and Bretagne Region

Duration: 24 months

Recruiting organization: UMR University of Rennes 1 - CNRS 6226 *Institut des Sciences Chimiques de Rennes* (ISCR), team “Organometallics: Materials & Catalysis”, group “Organometallic Catalysis and Fine Chemistry”,

Workplace: Building 10C, Campus de Beaulieu, Rennes – France

Skill area: metal catalysis (homogeneous and heterogeneous), molecular chemistry, green chemistry

Presentation of the host laboratory:

This post-doctoral position arises from the research cooperation between the group “Organometallic Catalysis and Fine Chemistry” of ISCR at University of Rennes 1 and the company Demeta S.A.S.

The group “*Organometallic Catalysis and Fine Chemistry*” is part of the “Organometallics: Materials and Catalysis” team from the “*Institut des Sciences Chimiques de Rennes*” (UMR UR1-CNRS 6226). The hosting group (9 researchers) has a strong international recognition in the field of homogeneous organometallic catalysis since more than 3 decades. Notably, more recently, it has focused its activity on the use of non-noble transition metals, C-H activation and applications towards green chemistry and sustainable development. (Average publication number per year: 50).

Demeta is a French privately-owned company leveraging disruptive, cost-effective and environmentally-friendly catalysis technologies to produce high value-added fine chemicals found in a wide range of applications. These include specialty chemicals, high performance polymers, flavors and fragrances, and active cosmetic and pharmaceutical intermediates. The catalytic expertise of Demeta relies on cutting-edge patented metal catalysts, more efficient, more cost-effective and more environmentally-friendly than conventional technologies.

With the common goal of developing greener industrial processes, both partners have joined their forces in the recent creation of the joint research and development center GreenCARE. The excellency of this new research project has been recognized through the “LabCom” labelling and funding program of the French National Research Agency (ANR), and by strong financial support of Bretagne Region.

The GreenCARE LabCom targets the development of new catalytic methodologies for greener oxidations of alkenes, considering this concept from the early academic research stage toward its industrial application.

Subject of the project:

Selective oxidations of alkenes are central to chemical industry. By adding value to the transformed molecules, these reactions enable the production of numerous derivatives of interest. More particularly, 1,2-diols formation from alkenes and their oxidative cleavage are both industrial reactions, applied to the production of synthetic intermediates, plasticizers, lubricants, monomers and cosmetic and pharmaceutical ingredients. Although very efficient, the current processes used for oxidation of alkenes into diols and their oxidative cleavage are strongly criticized due to the major industrial risk they represent. The reagents required by these conventional processes are expensive,

highly toxic and very polluting. Among them, osmium is the second rarest element in Earth crust and displays a toxicity even higher than mercury. Ozone, another reagent used under high temperature and pressure for the oxidative cleavage of alkenes, is highly explosive, as demonstrated by several recent industrial accidents.

Despite the recent emergence of a few osmium-free systems,^{1,2} a sustainable, efficient and cost-effective alternative still does not exist. The goal of this project will be to explore the potential of various alternative earth abundant metals in order to design green and marketable catalysts to perform these oxidations. An optimal system would be based on non-noble and low toxicity metals, and would perform the desired reactions in aerobic conditions, while enabling the recycling of the catalyst. The development of cooperative, multimetallic catalysts is a possible path toward such challenging requirements, thanks to the original electronic properties of the resulting entities.³ The main task of the candidate will be the design and development of efficient catalytic systems for both *syn*-dihydroxylation and oxidative cleavage of alkenes, by using resources and concepts of green chemistry. The candidate will work in a molecular chemistry laboratory environment, and will conduct experiments with modern synthetic equipment. Advanced analytical techniques (XRD, XPS, EDX, NMR, TEM/SEM...) will be intensively used to characterize the targeted catalysts. Ongoing exchange with Demeta company will ensure the development of industrial catalytic systems competitive toward the market. Hence, the candidate will have a unique opportunity to be involved in challenging fundamental research, in strong connection with its industrial development.

¹*Chem. Soc. Rev.*, **2011**, *40*, 114–128

²*ACS Catal.*, **2017**, *7*, 3050–3060

³*Chem. Rev.*, **2015**, *115*, 28–126

Candidate profile:

The candidate must hold a PhD in chemistry. Importantly, the successful applicant is expected to have a solid background in **transition metal catalysis**, **organometallic** and **organic chemistry**, and be able to conduct experiments with great care and reproducibility. Both homogeneous and heterogeneous catalysts will be targeted in this project. Interest in **green chemistry** and good **communication skills in English** (written and spoken) are of high importance. As Demeta will industrialize the technological outcomes of this joint research work, a constant attention will be given to the industrial transfer of processes. For this reason, knowledge in industrial chemistry will be considered as a merit. The applicant should be willing to work in an international and interdisciplinary research environment and be able to work independently as well as collaboratively.

Application procedure:

Applications should be sent by e-mail, in PDF format and contain:

- a letter of intent
- a detailed CV including previous research experiences
- a copy of the PhD diploma
- two confidential recommendation letters

Application will be addressed to both academic and industrial contact persons:

Contact at ISCR

Prof. Dr. Christophe Darcel

christophe.darcel@univ-rennes1.fr

Contact at Demeta S.A.S

Dr. Vincent Escande

vincent.escande@demeta-solutions.com

<https://iscr.univ-rennes1.fr/omc/organometallic-catalysis-and-fine-chemistry-group>