Séminaire ARCANE
13 mars 2020 – 14h à 17h
Amphi Rassat
470 rue de la Chimie, Campus universitaire

Programme :

14h – 15h **“Integration of Fragile Electrocatalysts into Devices for Energy Conversion”**

Nicolas Plumeré, Ruhr Univ. Bochum (Allemagne)

Widespread implementation of energy conversion devices cannot proceed without solutions that mitigate the cost of rare metal catalysts and the intrinsic O_2-instability of bio-inspired replacements. Recently, thick films of redox polymers were shown to prevent O_2 catalyst damage (1, 2), but also resulted in unnecessary catalyst load and mass transport limitations (3). Here, we apply novel methods for formation (4) and characterization (5) of homogeneous thin films that provide O_2-immunity while achieving highly efficient catalyst utilization (6). Resistance to O_2 inactivation can theoretically be obtained for non-limiting periods of time even when using highly fragile catalysts such as hydrogenases. Experimental lifetimes of hydrogenases under constant turnover in presence of O_2 can reach up to one week at the condition that protection also targets reactive oxygen species (7). Different protection mechanisms operate depending on matrix dimensions and intrinsic catalyst properties, and can be integrated together synergistically to achieve large and stable H_2 oxidation currents in the presence of O_2, potentially enabling a plethora of practical applications for bio-inspired catalysts in harsh oxidative conditions.

(1) *Nat. Chem.*, **2014**, *6*, 822–827
(2) *Angew. Chem. Int. Ed.*, **2015**, 54, 12329 –12333
(3) *JACS*, **2015**, *137*, 5494-5505
(4) *Chem. Sci.*, **2018**, 9, 7596-7605
(5) *Chem. Sci.*, **2020**, *11*, 937 – 946
(6) *JACS,* **2019**, *141*, 16734-16742
(7) *Nat. Comm.*, **2020**, *11,* 920.

Nicolas Plumeré obtained a PhD in inorganic chemistry and molecular electrochemistry in 2009 at the University of Tübingen (Germany). After a short fellowship as researcher at the company NECi (USA), Nicolas Plumeré became a group leader at the Center for Electrochemical Sciences at the Ruhr-Universität Bochum in 2010. He was promoted to a tenured professorship in analytical chemistry in 2017, and serves since 2019 as one of the PIs of the Excellence Cluster RESOLV from the German Research Foundation. He was granted an ERC starting grant in 2016 on catalysis for renewable energy and a ERC proof of concept grant in 2018 on sensing for sustainable agriculture. He acts on the council of the Bioelectrochemical Society and as an advisory board member of Chemical Science. He was awarded the 2019 Luigi Galvani Prize.

15h - 15h30 **“Achieving visible light-driven hydrogen evolution with hybrid systems based on semiconducting materials combined with molecular catalyst: Challenges and Advantages”**

Cristina Tapia-Garcia, Laboratoire de Chimie et Biologie des Métaux, équipe SolHyCat

Finding a competitive photoelectrochemical material-combination for hydrogen production is a promising way to succeed with the transition towards green technology. We will describe how cost-effective p-type light-harvesting semiconductors can be interfaced with molecular catalysts to prepare fully Earth-abundant element-based photocathodes that evolve hydrogen with quite positive onset photocurrent potentials.

15h30 - 16h **“Redox active glyconanoparticles and their use for bioelectrocatalysis”**

Andrew Gross, CNRS (CRCN), Département de Chimie Moléculaire, équipe BEA

Enzymatic biofuel cells are eco-friendly power sources but their stability is a major limitation. In our group, we have recently developed redox-active glyconanoparticles as solution-based electron shuttles for electrocatalytic glucose oxidation and oxygen reduction. In this presentation, the characterisation and bioelectrocatalysis of these particles will be introduced, as well as the new solubilised biofuel cell concept (SEFC) for multi-day quasi-continuous power generation.

16h - 17h Discussions around a drink