COLLÈGE DE FRANCE 1530

INSTITUT DE CHIMIE

ANNÉE ACADÉMIQUE 2014-2015

Le 4 mai 2015 à 11 heures
Salle 2

Prof. Hubert Girault was appointed Professor of Physical Chemistry at the Ecole Polytechnique Fédérale de Lausanne (Switzerland) in 1992 and has been Director of the "Laboratoire d'Electrochimie Physique et Analytique" ever since its creation.

His research career started in 1979 in the field of electrochemistry at soft interfaces. In 1985, he developed an interest in electro-analytical chemistry, then in Lab on Chip techniques and since 2000 he has also been very active in the field of bio-analytical chemistry in particular in immunoassays, electrophoresis, proteomics and mass spectrometry. Since 2000, he runs a comprehensive research program on artificial water splitting and carbon dioxide reduction at soft interfaces. His laboratory is now installing large-scale pilot plants for indirect water electrolysis using redox flow batteries.

Prof. Hubert H. Girault
Professor of Physical & Analytical Chemistry
Ecole Polytechnique Fédérale de Lausanne

REDOX CATALYSIS FOR WATER SPLITTING AND CO2 REDUCTION.

First, I shall present our demonstrator **plant for the production of hydrogen** using a commercial vanadium redox battery (10 kW installed, 200kW in preparation). The process is based on the redox catalysis of protons by vanadium (II) outside the battery in an external circuit comprising a catalytic bed of Mo2C on ceramic. The physico-chemical principal of redox catalysis on metallic nanoparticles will be discussed.

Then, I shall present our "dream" project of **batch water splitting using biphasic systems**. The idea is to use two biphasic water/oil systems. In both systems, we place in the oil phase an electron D and an electron acceptor A. In system 1, we have a catalyst for proton reduction and in system 2 one catalyst for water oxidation. Under day light, system 1 produces hydrogen and the donor is oxidised and system 2 produces oxygen and the acceptor is reduced. At night, the two oil phases are mixed to reset the redox couples. This membraneless approach provides a means to generate H2 and O2 separately.

Thirdly, I shall present our work on **photo-ionic cells to convert solar energy** and to generate electricity on demand. The concept is also based on a biphasic system. We place for example a cationic dye in water together with a redox quencher. Upon photo reaction, the neutral reduced dye is extracted to the organic phase. The two phases are then separated and the energy is then stored as redox energy. To recover this energy, we pass the two solutions in an electrochemical flow cell to generate electricity on demand.

Finally, I shall present our work on **CO2 reduction using super critical CO2**. First, I shall present the photoreduction of CO2 at the water/sc CO2 interface and then present our electrochemical investigations of CO2 reduction in scCO2-solvent mixtures using metal-organic catalysts.