



## Bio-inspired Materials Conference

Sustainable Materials Inspired by  
the Living world for Energy

Rueil-Malmaison (near Paris), France ■ 6-8 April 2016

The **SMILE 2016** (Sustainable Materials Inspired by the Living world for Energy) scientific conference, held at IFPEN Rueil-Malmaison from 6 to 8 April 2016, brought together some 60 participants - from academia and industry - from 12 countries (including China, the USA and Russia) to discuss the synthesis of bio-inspired materials.

The opening session led by Prof J. Livage (Collège de France) set out the enormous potential of the biomimetic approach to materials synthesis. The purpose of the following three sessions, focusing on the themes of "bio-inspired functional materials", "bio-inspiration for photocatalysis and electrocatalysis" and "bio-inspired heterogeneous catalysts", was to draw up a full overview of progress and research under way in the field. In addition to these purely scientific presentations, industry representatives (from St Gobain, Renault, Air Liquide, Elbé Petro) underlined the specific contribution of bio-inspiration to their innovation activities as an approach in its own right. Following these presentations, a round table led by A. Renaudin (NewCorp Conseil, France) alongside K. Raskin ([CEEBIOS](#), France) led to fruitful exchanges between the speakers and participants, as well as those following proceedings on social media.

The functions and properties developed - and also the most widely studied - that can be found in nature include:

- Surface properties (hydrophobicity/hydrophilicity, liquid/dry medium adhesion, self-cleaning surfaces)
- Thermal exchange regulation
- Mass transport properties,
- Friction control, flow reduction
- Mechanical properties
- Controlled light absorption between total absorption (black materials) and selective absorption (reflection, photonic crystal filtration).

These properties are generally obtained in the living world via the implementation of surface or volume nanostructuring, hierarchical or multi-scale periodic porosity or complex supramolecular assemblies.

During the session devoted to "**bio-inspired functional materials**", Prof. Y. Zheng (Beihang University, China) presented his research on the "dynamic" wettability of surfaces inspired by numerous living organisms, with multiple applications concerning, for example, water recovery by condensation, de-icing (aircraft wings, wind turbine blades) and any other process using the properties of superficial hydrophobicity/hydrophilicity. The properties of self-cleaning surfaces were also presented by Prof. B. Bushan (Ohio State University, USA). The effect is obtained thanks to surface nanostructures that trap air pockets (as in the lotus leaf, for example) or generate microturbulences capable of preventing waste materials or microorganisms from adhering (as in shark skin, for example). Some of the original synthesis approaches include biopolymer mineralization (Prof. Y. Shchipunov, Russian Academy of Sciences, Russia) and so-called "integrative" methodology developed at the Paul Pascal Research Center (CRPP) in Bordeaux (Prof. R. Backov) to obtain hierarchically porous alveolar monoliths.

In the field of **photocatalysis**, where bio-inspiration plays a significant role, materials replicating the microstructures of textured butterfly wings to absorb visible light make it possible to substantially improve water photolysis and color mineralization performances (Prof. X. Fan Shanghai University, China). Similarly, the reproduction of plant transport properties (leaves, for example) in hierarchically porous structures or butterfly wings to maximize absorption in the IR spectrum (40% of the solar spectrum) has led to significant progress in the field. Finally, on a molecular scale, research inspired by natural photosynthesis is opening up promising perspectives for the discovery of new systems for the photo-reduction of CO<sub>2</sub> (Prof. A. Aukauloo, Paris XI University).

The session dedicated to **bio-inspired heterogeneous catalysts and processes** began with a lecture by Prof. M.O. Coppens (University College of London, UK), who presented several examples of process improvements achieved via a bio-inspired approach (particularly liquid/gas mixers with fractal geometry). The session also examined the modification of the surface of alumina supports by the use of bio-polymers (R. Munirathinam, IFP Energies nouvelles), the use of bio-inspired liquid membranes for the conversion of glucose by dual catalysis (A. Gimbernat, University of Lille) and the use of HIPE-type alveolar structures containing Cobalt for Fischer-Tropsch synthesis (G. Queiroz, Bremen University, Germany).

To conclude: the SMILE 2016 scientific conference brought together international teams of researchers and industrial players who have already adopted a bio-inspired approach (some are even using prebiotic\* chemistry). The various sessions highlighted some of the latest developments emerging from R&D programs under way around the world, particularly in Germany (presentation by K. Raskin), and the implementation of this innovative approach, from laboratory scale through to industrial development tools.

\*branch of biochemistry dedicated to the study of processes prior to the advent of life