doi:10.2533/chimia.2016.907 Chimia 70 (2016) 907–908 


# Conference Report

## CLARIANT bestows CleanTech Award 2016

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- CleanTech Award 2016 presented for outstanding achievements in the field of 'Sustainable Chemistry'
- Third Clariant Chemistry Day at the University of Basel
- Knowledge sharing between industry and academia

Clariant, a global leader in specialty chemicals, presented the CleanTech Award for outstanding scientific achievements in the field of 'Sustainable Chemistry' as part of the third Clariant Chemistry Day that took place at University of Basel on October 12, 2016. This year, the accolade was awarded throughout Switzerland for the first time in collaboration with the University of Basel and the Swiss Chemical Society. First prize went to Jingshan Luo of the École Polytechnique Fédérale de Lausanne for his accomplishments in hydrogen fuel generation as a future energy source *via* solar water splitting. Britta Fuenfstueck, member of the Executive Committee at Clariant, presented the award to the beaming winner: "Today's awardees achieved remarkable results that contribute to tackling the challenges of our society by creating product and process innovation."

### Clariant CleanTech Award Switzerland

- 1st: Jingshan Luo, EPF Lausanne
  'Hydrogen fuel generation *via* solar water splitting'
- 2nd: Markus Jeschek, ETH Zürich/University of Basel
  'Directed evolution of artificial metalloenzymes for *in vivo* olefin metathesis'
- 2nd: Amit, Nagarkar, University of Fribourg
  'Catalytic living ring-opening metathesis polymerization : Significant reduction of the ruthenium catalyst loading'
- 4th: Fang Song, EPF Lausanne
  'Improved water splitting: Focus on oxygen generation as rate determining step'

### Clariant Chemistry Award at the University of Basel

- 1st: Laura Allegra Büldt, University of Basel
  'A New Class of Luminophors and Photocatalysts for Challenging, Visible Light Driven Reactions Based on Earth-Abundant Metals'

Before the award ceremony, more than 100 students and industry representatives took part in an exciting event dedicated to the exchange of information between industry and academia. In addition to the nominees for the CleanTech Award, Laura Allegra Büldt, winner of the Chemistry Award at the University of Basel, also presented her research results. Guest speaker Professor Ronny Neumann from the Weizmann Institute of Science in Israel also gave a talk about 'Polyoxometalates for Catalytic Oxidation and Reduction and their use for Sustainable Transformations'. In addition, almost 30 attendees from all over Switzerland presented their science projects on the theme of sustainable chemistry with poster presentations. At the end, the jury elected Christian Fischer from the University of Basel as the winner of the Poster Award for his work.

Explaining the idea behind the Clariant Chemistry Day, Dr. Martin Vollmer, Chief Technology Officer at Clariant, said: "It is important to us that we actively promote knowledge sharing between students, researchers, and companies, and foster young talents with their research projects in the field of sustainable chemistry." Professor Marcel Mayor, Head of the Department of Chemistry at the University of Basel, was equally enthusiastic about the concept: "The Chemistry Day creates a better understanding of how cooperation between academic researchers and industry can add value for our society."

This was the third Chemistry Day organized by Clariant, and the company has also used the event to give insights into current research projects.

Clariant has been active in catalytic hydrogenation for more than 30 years. Andreas Geisbauer, R&D Global Technology Scout at Clariant's Business Unit Catalysts, explained the important contributions to the development of the so-called Liquid Organic Hydrogen Carrier Concept that have been achieved based on this expertise: to enable the transition to renewable energy systems hydrogen, produced from renewable electricity by electrolysis, is catalytically transferred to the liquid carrier molecule from which hydrogen later, after storage or transport, can be released by suitable dehydrogenation catalysts.

The big advantage of the concept is the high energy density of the hydrogenated hydrocarbon carrier, easy to store and to transport, as it is liquid at ambient conditions.

The latest version of Clariant's EleMax™ dehydrogenation catalyst proved outstanding performance with regard to activity and selectivity and elevates the attractiveness of the LOHC concept to the next level for various industrial applications.

Georg Schirrmacher, member of Clariant's Group Biotechnology, gave a lecture about 'Lipids and Surface active Substances from Marine Biomass (LIPOMAR)'. In the project, which is funded by German Federal Ministry of Education and Research (FKZ 031A261), methods and processes for obtaining high-quality specialty chemicals, such as oleochemicals and surfactants, were developed from ubiquitously available marine biomass (*e.g.* macroalgae). Based on their chemical composition, macroalgae are an attractive third-generation feedstock for oleochemicals and surfactants. Various enzymes were identified, produced and evaluated to hydrolyze the marine biomass and to get access to the enclosed carbohydrates. The resulting mixtures of sugars and sugar acids, whose composition is very different from other renewable biomass sources, were used for fermentation by microorganisms to lipids and lipid derivatives, and further used for the biocatalytic production of new surfactants.

Project partners in the project were Clariant (Group Biotechnology), Hamburg University of Technology (Institute of Technical Microbiology, Prof. Antranikian), Fraunhofer (Bio, Electro and Chemocatalysis BioCat, Prof. Sieber) and Technische Universität München (Chair for Industrial Biocatalysis, Prof. Brück).

*http://www.clariant.com/en/Corporate/News/2016/10/Clariant-bestows-CleanTech-Award*

## Winner of the Clariant CleanTech Award 2016: Jingshan Luo, EPF Lausanne

Jingshan conceived the idea and led the work of coupling novel Earth-abundant catalysts to perovskite solar cells for the generation of hydrogen fuel *via* solar water splitting in the group of Prof. Graetzel at EPF Lausanne, achieving a record of 12.3% solar to hydrogen conversion efficiency. This is a remarkable achievement for solar hydrogen generation using only inexpensive materials, and it was published in the prestigious *Science* journal.[1] He was the lead author of this seminal paper. It was widely reported across the media and well-recognized in the research community. In less than two years, it has been cited 381 times according to Google Scholar.

Following that, Jingshan broadened the light harvesting range by designing an ideal dual-absorber tandem solar water splitting system using perovskite photovoltaics as the top absorber and CIGS photocathodes as the bottom absorber, which maximizes the theoretical solar to hydrogen efficiency to 27%.[2] Furthermore, with a bipolar membrane for gas separation and maintaining the pH gradient in the two compartments, he built an efficient and intrinsically safe solar-driven water splitting system, composed of Earth-abundant catalysts for hydrogen evolution in acid and oxygen evolution in base and perovskite light harvesters, achieving a new benchmark solar to hydrogen conversion efficiency of 12.7%.[3]

Besides leading the project using perovskite photovoltaics and Earth-abundant catalysts for water splitting, Jingshan also made outstanding contributions to copper-based photocathodes for photoelectrochemical water splitting. He has advanced the performance of $Cu_2O$ photocathodes for water splitting to a record high current density[4] and developed a new solution based method to transform $Cu_2O$ into $CuInS_2$.[5]

*Text by M. Graetzel (from the application dossier)*

## Winner of the Clariant Chemistry Award at the University of Basel 2016: Laura Allegra Büldt, University of Basel

During her PhD studies, Laura Allegra developed a new class of metal complexes with long-lived excited states which are potentially amenable to lighting and photoredox applications. Laura achieved this goal with her work on isocyanide complexes of molybdenum(0) which are isoelectronic with the famous and widely used Ru(2,2'-bipyridine)$_3^{2+}$ complex. Her Mo(0) complex is robust, exhibits long-lived red emission, and it is an extremely strong reducing agent in its excited state. Consequently, this Mo(0) complex is able to catalyze reactions which cannot be catalyzed by conventional (ruthenium- or iridium-based) photoredox sensitizers.

The idea of using chelating isocyanide ligands combined with Mo(0) to obtain robust analogues of Ru(2,2'-bipyridine)$_3^{2+}$ is conceptually novel, and the photoredox application which Laura put in evidence is unprecedented. This has been recognized by the reviewers of Laura's recent article in *Angew. Chem. Int. Ed.*[6]

Laura has also discovered a luminescent Cr(0) isocyanide complex which can be considered an analogue of the non-emissive Fe(2,2'-bipyridine)$_3^{2+}$ complex. The results of this work are potentially of interest to the community working on dye-sensitized solar cells.

*Text by O. Wenger (from the application dossier)*

Received: November 16, 2016

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Britta Fuenfstueck (left), member of the Executive Committee at Clariant, Martin Vollmer (right), Chief Technology Officer at Clariant, and the winner of the first price of the Clariant CleanTech Award Jingshan Luo (middle) of the École Polytechnique Fédérale de Lausanne (EPFL). (Photo: Clariant)