Catalysis for hydrogen storage - A special issue in honor of Prof. Gabor Laurenczy

Umit Demirci, Yuichi Himeda, Qiang Xu

INTERNATIONAL JOURNAL OF HYDROGEN ENERGY 44 (2019) 28389–28390

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/he

Editorial

Catalysis for hydrogen storage - A special issue in honor of Prof. Gabor Laurenczy

The present energy context is still dominated by fossil fuels but, since recently we are in a transition to renewable and sustainable solutions like hydrogen! Hydrogen is a clean energy, with potentially zero emission of additional carbon dioxide CO_2. Its development is however confronted with issues related to the entire hydrogen chain (i.e. production, storage, distribution, and end-use).

The problems of storage and transport remain, due to low volumetric energy density of hydrogen. Besides the conventional storage approaches (i.e. physical storage considering high pressure and/or low temperature), a number of alternative solutions have emerged within the past two decades. One of these promising solutions is reversible storage of hydrogen in the form of liquid-phase chemicals (i.e. hydrogen carriers), a typical example of which being formic acid HCOOH.

The present special issue focuses on some examples of attractive liquid-phase chemical hydrogen carriers through the contribution of 15 research groups from all over the world (Australia, China, Germany, Hungary, Japan, Netherlands, Saudi Arabia, Spain, and Turkey). The proposed research articles report new research results on the major challenges encountered by carriers like alcohols (e.g. glycerol, butanediol and methanol), boron-based hydrides (e.g. sodium borohydride and ammonia-/hydrazine-borane), hydrous hydrazine, water, and formic acid (and formate), with a special focus on the use of catalyst for their dehydrogenation.

In the special issue, there are specifically six research articles dealing with formic acid. To the research area of chemical hydrogen storage, in particular, with this sustainable liquid organic carrier, **Prof. Gabor Laurenczy** has made ground-breaking contributions. It is natural, then, that Gabor, professor at the Ecole Polytechnique Fédérale de Lausanne (EPFL) in Switzerland, is honored with the present **special issue to celebrate his 65th birthday**.

Prof. Gabor Laurenczy was born and raised in Hungary, studying chemistry at Kossuth University in Debrecen and following his bachelor (1978) and doctoral (1980) studies became an assistant professor at the same university and obtaining a habilitation from the Hungarian Academy of Sciences. In 1985, he took up a position at the University of Lausanne in Switzerland, with chemistry transferring to the EPFL in 2001. In 2010, he was nominated professor.

While in Lausanne, Prof. Gabor Laurenczy applied his fundamental knowledge of reaction kinetics to study homogeneous catalysts, small molecule activation working extensively with medium pressure sapphire NMR tubes to detect catalytic intermediates and elucidate reaction mechanisms. His expertise was greatly appreciated by many people in the field and he was extremely collaborative and over the years he hosted more than 50 young researchers.

In 2008, Gabor and co-workers published a seminal paper on the discovery of a homogeneous water soluble ruthenium catalyst for the selective dehydrogenation of formic acid to hydrogen and carbon dioxide (Angew Chem Int Ed 2008; 47:3966–8). Remarkably, the catalyst overcame the limitations of previously reported catalysts, demonstrating both extraordinary stability and the ability to produce high pressures of hydrogen. A series of publications elaborating on the mechanism and describing other catalysts followed, and as the initiation invention was patented, a commercial process was developed together with a company. Prof. Gabor Laurenczy was also determined to find more efficient processes to produce formic acid from the direct hydrogenation of carbon dioxide, and in 2014 reported on a base-free system that afforded formic acid in concentrations an order of magnitude higher than previously achieved (Nature Commun 2014; 5:4017). Again, this discovery led to much excitement in the community.

Prof. Gabor Laurenczy has continued to develop both sides of the formic acid-hydrogen/carbon dioxide cycle at both a fundamental level and also producing prototype reactors. Not surprisingly, based on his accomplishments, he has been

invited to give many lectures worldwide and has written the benchmark reviews in the field.

Beyond his research, all those who know Prof. Gabor Laurenczy personally appreciate his warm and generous character. This short *editorial* to the IJHE special issue compiled in honor of Gabor Laurenczy on the occasion of his 65th birthday is a good opportunity to cordially thank him for his friendship. It has always been a great pleasure to be together with him and to enjoy his optimistic view of life, his humor and his wonderful and generous personality. We thank Gabor for all this and salute him with this special issue and wish him all the best.

Happy birthday, Gabor!

Umit B. Demirci*
Institut Européen des Membranes, IEM – UMR 5635, ENSCM, CNRS, Univ Montpellier, Montpellier, France

Yuichi Himeda
National Institute of Advanced Industrial Science and Technology, AIST Tsukuba West, 16-1 Onogawa, Tsukuba, Ibaraki 305-8569, Japan
E-mail address: himeda.y@aist.go.jp (Y. Himeda)

Qiang Xu
AIST-Kyoto University Chemical Energy Materials Open Innovation Laboratory (ChEM-OIL), National Institute of Advanced Industrial Science and Technology (AIST), Kyoto 606-8501, Japan
E-mail address: q.xu@aist.go.jp (Q. Xu)

**Corresponding author.*
E-mail address: umit.demirci@umontpellier.fr (U.B. Demirci)

Available online 4 October 2019

https://doi.org/10.1016/j.ijhydene.2019.09.112