FROM LIGHT TO COMPLEX: TWISTS AND TURNS IN THE RESEARCH ON LIGHT COMPLEX HYDRIDES

Yaroslav Filinchuk[a]

[a] Institute of Condensed Matter and Nanosciences, Université catholique de Louvain, Louvain-la-Neuve, Belgium

e-mail: yaroslav.filinchuk@uclouvain.be URL: www.filinchuk.com

I would like to start the talk by recent examples of hydrogen storage applications and discuss different approaches taken. The rest of the talk will be dedicated to the chemistry of light complex hydrides.

The demand for materials with high energy density has driven the research from metal hydrides, having by now excellent cycling properties and the thermodynamics, to much lighter systems based on light *p*-elements bound to hydrogen atoms. The need to break and form strong covalent bonds raises difficulties in the design of these truly "chemical" hydrogen storage systems. Advances in this area started with the discovery of catalysts for the reversible dehydrogenation of alanates [1], and this success inspired the research on even more sturdy borohydrides. Despite the influence of metal's electronegativity on the decomposition temperatures of $M(BH_4)_n$ has been known since long ago [2], a combination of different metals was used to tune the decomposition temperature in the wide range only recently [3]. For example, complex anions $[Zn(BH_4)_3]^-$ and $[Zn_2(BH_4)_5]^-$ balanced by alkali metal cations allow to exploit Zn borohydride, unstable in pure form at room temperature. Formation of borohydride complexes has been recognized as a design principle, opening the door to the discovery of many new metal borohydrides. I will present design of light complex hydrides based on aluminium chemistry, where Al^{3+} serves as a template for H-conversion [45]. To achieve the ultimate goal of the reversible hydrogen storage using light complex hydrides, the reactive hydride composites (RHCs) have to be explored [5], considering many combinations of the high H-capacity materials.

An unexpected outcome of the directional metal-borohydride interaction are the porous and dense frameworks containing less electropositive Mg and Mn [6], where the BH_4 units serve as linear linkers. Combining hydridic and classical ligands (such as imidazolates, *Im*) results in stable hydridic compounds, where the *Im* supports the framework and the BH_4 provides the functionality. I will present the strategy of obtaining porous hydridic MOFs and new unusual properties discovered so far.

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Yaroslav Filinchuk studied Chemistry at Lviv National University and received PhD in Inorganic Chemistry in 2002. He joined the University of Geneva in 2000, where he begun to work on metal hydrides with Prof. Klaus Yvon. In 2006-2010 he worked at the Swiss-Norwegian Beam Lines at the European Synchrotron Radiation Facility. Since 2011 he is a professor of structural chemistry at the Université catholique de Louvain (UCL, Belgium). He received ESRF young scientist award in 2010 and published about 200 papers (h index 41). His research interests include chemistry of hydrogen-rich solids, in particular for hydrogen storage, porous materials, and various applications of crystallography in materials science.