Editorial: Materials for Energy Conversion

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As the title of George Harrison's 1973 album says, we are 'Living in a Material World'. Materials chemistry has undergone a transformation in the past 30 years, both with a recognition that 'hard' and 'soft' condensed matter can happily live with one another and with the development of new materials with smart and responsive properties. The major challenge facing mankind in the next 100 years will be living with, and adapting to, the realities of climate change. Whether or not the body politic implements its responsibilities under the Paris Accord, major changes will be needed in the technological and societal aspects of the future energy sector. Processes will need to be greener and cleaner and the reliance on fossil fuels will need to be reduced in parallel with the implementation of 'carbon zero' policies with the implication of new technologies for the use of renewables as well as carbon trapping and a closed technology carbon cycle. All of this technology change can only be stimulated by shifting paradigms in molecular, catalytic and materials chemistry. This issue of *Chimia* with the theme *Materials for Energy Conversion* will highlight some of the important contributions being made by Swiss chemists to this globally crucial theme.

In the article *Boron Hydrogen Compounds for Hydrogen Storage and as Solid Ionic Conductors,* Hans Hagemann describes progress in the area of metal borohydrides as potential hydrogen storage materials, as well as the applications of hydridoborate and hydridocarborate compounds as ionic conductors for all-solid-state lithium or sodium batteries. The topic of developing and understanding materials for use in the hydrogen economy is further developed in the manuscript *Hole and Protonic Polarons in Perovskites* by Artur Braun and co-workers where fundamental questions relating to the mechanisms of charge transfer in perovskite materials are addressed. The question of the responsible use of finite resources and the development of closed-cycle technologies is the topic of the paper *Renewable Energy from Finite Resources: Example of Emerging Photovoltaics* by Markus Lenz and co-workers. This latter paper also touches on the question of how effectively we are implementing a sustainable materials chemistry based upon Earth abundant elements and elements which are environmentally benign. The design of materials based on perovskite-type oxides and oxynitrides for electrochemical, photo(electro)chemical and catalytic processes is the basis of the contribution *Energy Conversion Processes with Perovskite-type Materials* from Davide Ferri and co-workers. The theme of photovoltaics continues in the manuscript entitled *Photoelectrochemical Cells Based on Dye Sensitization for Electricity and Fuel Production* by Nick Vlachopoulos and Anders Hagfeldt. In the article *Surface Modifications on Positive-Electrode Materials for Lithium Ion Batteries*, Katharina Fromm and colleagues describe how molecular chemistry can be used to modify interfacial surfaces to develop emerging properties. The importance of the chosen field, lithium ion batteries, is recognized by the award of the 2019 Nobel Prize in chemistry to Yoshino, Whittingham and Goodenough for their pioneering work in this area. Understanding molecular catalysts for reactions of 'simple' molecules such as dihydrogen, dioxygen, water and carbon dioxide will be critical to the development of new technologies for energy storage and carbon-trapping, and the manuscript by Gurdal, Probst and colleagues entitled *$[Co^{II}(BPyPy_2COH)(OH_2)_2]^{2+}$: A Catalytic Pourbaix Diagram and AIMD Simulations on four Key Intermediates* describes detailed studies of a prototype system. A broader overview of the development of catalysts for carbon trapping is given in the contribution *Bimetallic Electrocatalysts for Carbon Dioxide Reduction* from Michael Grätzel and co-workers. Finally, the use of interfacial methods for carbon-trapping is addressed in the paper entitled *Testing a Silver Nanowire Catalyst for the Selective CO_2 Reduction in a Gas Diffusion Electrode Half-cell Setup Enabling High Mass Transport Conditions* by Peter Broekmann, Matthias Arenz and colleagues.

We think that this issue of *Chimia* provides an overview of the breadth and quality of Swiss research in this critically important area and will also inspire others to bring their own skill sets to the problems associated with materials design for such cutting edge applications.

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***Credits for the cover illustration**:* centre, coin Li-ion cell and LED (Katharina Fromm and Nam Hee Kwon, University of Fribourg); bottom left, emissive copper(I) compounds (Isaak Nohara, University of Basel); top left: perovskite lattice (Catherine Housecroft, University of Basel, using data from the Cambridge Structural Database, refcode BARHOU01 K. Du *et al.*, *Inorg. Chem.*, 2017, **56**, 9291); top right (Edwin Constable, University of Basel); bottom right: α-hematite image generated using CrystalMaker® (a crystal and molecular structures program for Mac and Windows. CrystalMaker Software Ltd, Oxford, England, *www.crystalmaker.com*) (Edwin Constable, University of Basel).

The Editorial Board of CHIMIA warmly thanks Catherine Housecroft and Edwin Constable for planning and realising this excellent issue on 'Materials for Energy Conversion' and continuing the series of special topic issues that address sustainablity in chemical and energy technology.