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Editorial

Preface to the special section on materials for chemical and electrochemical energy storage

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It is well known that the widespread usage of fossil fuels has resulted in a steady rise of the CO_2 level in the atmosphere. The calculated average CO_2 level in the atmosphere during the pre-industrial revolution period fluctuated between 180 ppm (during ice ages) and 280 ppm (during interglacial warm periods). According to the measurements of Charles David Keeling, in 1958 the atmospheric CO_2 concentration was around 317 ppm. This value has risen dramatically since then and, since 2017, it has settled constantly above 400 ppm. Without a doubt, this resulted in a change in natural atmospheric equilibria, which in turn resulted in a sensible increase in the average Earth temperature.

The replacement of environmentally harmful fossil fuels with renewable energy sources appears to be highly appealing from both an environmental and a safety standpoint due to the lack of toxic products emerging from their usage. However, their intermittent nature and uneven distribution on Earth are shortcomings that need the identification of suitable energy carriers, as well as the development of (yet undiscovered) technologies that will permit their efficient and synergic utilization.

Thus, the urgent demand for energy storage materials in order to build a sustainable and carbon-free society is driving a new era in the development of efficient energy storage and conversion materials. For example, hydride-based all-solid-state batteries or batteries based on cations different from Li^+ e.g. Na^+ and Mg^{2+} are safer, cheaper, and have the potential for achieving higher energy density. New reactive hydride composite systems (RHCs) for hydrogen storage with operating temperatures close to room temperature are now within reach. New solutions are being developed to address the issue of intermittent supply from renewable energy sources by synthesizing energy carriers such as H_2, CH_4, CH_3OH, and other molecules (e.g., through sunlight-driven processes) to provide an uninterrupted and

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sustainable supply of energy for stationary systems and zero-emission vehicles.

In this scenario, young and experienced researchers from various fields were brought together as part of the EMRS Fall Meeting 2021 Symposium "Materials for Chemical and Electrochemical Energy Storage," held in Warsaw between September 14 and September 17, with the goal of creating a unique opportunity to share their expertise.

The eight papers briefly presented here, constitute a selection of the symposium's subjects.

Bowen Li and coworkers reported the use of chitosan-derived graphitic carbon@Fe3C composites (CSGC@Fe3C) as anode material for LIBs was prepared by a simple pyrolysis method.

Samah M. Bekhit and coworkers synthesized snow crystal-like NiSe using a direct growth solvothermal method using hexamine as a reducing agent. The peculiar morphology provided unique electrochemical properties.

Xin Qi and coworkers reported on the delamination of the Nb_2C MXene using a chlorophyll derivative (zinc methyl 3-divinyl-3-hydroxymethyl pyropheophorbide a (Chl)) to produce Chl@Nb_2C composites as the anode materials for lithium-ion batteries. They discovered that the electrochemical properties of the delaminated Chl@Nb_2C composite electrodes outperformed those of the multilayered pristine Nb_2C electrodes.

Huizi Zhao and coworkers reported on a novel hexaaminobenzene-based triangular-topology covalent organic framework (HAB-COF) used as anode material in lithium ion batteries. Remarkably, upon a capacity-increasing and/or activation process, the HAB-COF organic electrode delivered high reversible capacities and excellent cycle life.

Zhanhui Peng and coworkers described the charge–discharge behavior of a series of lead-free relaxor ceramics (1-x)$K_{0.5}Na_{0.5}Nb_{O3}$-xLa$(Mn_{0.5}Ni_{0.5})$-$_{O3}$ (KNN-xLMN).

Min Zeng and coworkers designed an efficient strategy to prepare CC/MoO_3 electrodes with in situ deposited Li_2S_8. They demonstrated that the obtained unique structure, owing to the strong polarity of MoO_3 and the excellent conductivity of the CC matrix, led to the achievement of appealing electrochemical properties.

Valeria Farina and coworkers reported on the transformation of olivine during the conversion of CO_2 to light hydrocarbons under mechano-chemical treatments at different impact frequencies. The work was carried out via a combination of several characterization methods, including X-ray diffraction, Raman, and ^{57}Fe Mössbauer spectroscopy.

Gokhan Gizer and colleagues investigated the effect of KH on the hydrogen storage properties of the system $Mg(NH_2)_2 + 2LiH$, as well as the effect of KH particle size dimension on the same. The investigation was carried out by applying different laboratory and synchrotron characterization techniques.

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