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EDITORIAL

Preface on "Nanomaterials for Energy Conversion and Storage Systems"

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Research in the field of energy conversion technologies and development of efficient energy storage systems has shown numerous breakthroughs recently. Therefore, the world economy is transforming from a carbon-intensive economy to a renewable energy-based economy. There is a high demand for such energy services which are popular due to its availability and efficiency and has increased the efforts of researchers to work with unintended sources, leading to world's global warming pollution. For example, search for renewable resources to conserve energy and development of novel technologies to capture carbon dioxide and possible conversion into valuable products are very crucial to preserve the environment. Thus, developing other alternatives, such as recycling CO_2 to develop carbon neutral economy, will help in preserving the ecosystem by reducing emissions at local and universal levels. Multidisciplinary fields involving nanotechnology and nanoscience creates the need from different science fields, such as chemistry, biology, physics, materials science, and engineering to work together and fulfill future challenges for sustainable energy storage and conversion technologies. Particularly, nanomaterials consisting distinct characteristics and surface properties have led to an enormous scope in this process.

Nanomaterials is the core of designing advanced energy conversion technologies and efficient energy storage systems. It offers miscellaneous functionalities and opens a platform essential for originating tunable chemical and electronic properties which can be used for desired applications. It has variable structural dimension (zero to three), and these nanomaterials are not only used for direct application but also as a functional substrate for other atomic/nano materials deposition for energy-related applications. In addition of traditional zero-dimensional nanomaterial, relatively new two-dimensional nanostructures such as graphene, Mxene and their hybrid nanostructures have revolutionized the energy conversion technologies and efficient energy storage systems ranging from batteries to electro-/photochemically generated liquid fuels. Among many advantageous characteristics, one specific benefit of these two-dimensional nanostructures is freedom of ability to introduce desired electronical and chemical localized environment at atomic scale which can be used for numerous applications including energy storage systems or catalytic applications. These nanomaterials have also shown the progressive footprint in developing carbon neutral economy. Moreover, present research outputs have shown promising progress and the targeted futuristic goals of energy conversion technologies. Efficient energy storage systems will be accomplished by the application of these emerging nanomaterials with outstanding functionally and performance as seen never before.

Therefore, we organized a special issue (SI) on "Nanomaterials for Energy Conversion and Storage Systems" to highlight research at the forefront of this exciting field, inviting contributions (perspective, research or review papers) addressing novel nanomaterials, energy conversion, energy storage, and photo- or electrocatalytic processes. This SI contains 17 contributions, including 15 research papers, 1 letter, and 1 review contributed from the world-leading experts working in the field of energy conversion and storage systems.

The topics covered in this SI of Emergent Materials include synthesis and characterization of the novel nanomaterials and nanostructures; surface functionalization of nanomaterials;

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energy storage efficiency of batteries, fuel cells, and ultracapacitors; interpretation and empirical analysis of the process involving storage and conversion of renewable energy; nanocatalysts for electrochemical hydrogen production, electrochemical hydrogenation process, oxygen reduction and evolution reactions, and CO_2 electrochemical conversion reactions; alloys, synthesis, and designing of renewable energy applications; understanding of electrocatalytic reactions mechanism occurring at the surface of nanomaterials; nanomaterials for energy storage applications.

In each of the articles within the special issue, there is a novel significance and contribution of synthesis and usage of nanomaterials for energy conversion and storage applications. We are certain that this special issue would aid the energy research community to recognize a key direction for the science and technology towards advanced emergent materials in energy conversion and storage.

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