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EDITORIAL

Advanced materials for sustainable energy and applications

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This special issue discusses a variety of topics, with a focus on basic research and research applications in industrial and environmental applications for advanced materials for sustainable energy and applications. Advanced materials are new sorts of materials that require major modifications to current materials in order to attain superior and novel features that are particularly valuable in the field of materials science. Advanced materials are mainly of four types, including alloys, polymers (bio- or nano-engineered), and porous materials with their unique properties for potential applications in the fields of transport, building, aerospace, health care, etc. Advanced materials can now be employed for sustainable energy applications ranging from generation to storage; however, there are also significant obstacles in developing alternative materials for the conservation and harvesting of the green environment. In the current state of the art, solid-state battery technologies are based on advanced materials and are implemented to produce transport systems with the highest performance, which meets international standards for pollution control and less carbon (e.g., CFC, CO_2) production. The development of advanced materials through the use of new cost-effective technologies may enhance competition in the market as well as in industry. Advanced materials are also used for PV and solar cell technologies in materials science to maintain our carbon emissions per capita at the international level.

In recent years, the development of smart materials and their various applications in the fields of science and technology has attracted a great deal of interest. Renewable resources are one of the categories known as solar cells. Traditional solar cells are used with maximum conversion efficiency, but researchers are now trying to find more alternatives for the traditional cell due to its limitations and problems. It is significant that the advanced materials used for solar cells are of the highest quality in thin film, crystalline silicon, concentrated photovoltaic, or solar power applications, which enables the devices to have high performance and long-lasting stability. A new category (perovskite solar cells) is also proposed for the highest efficiency compared to other solar cells but is not economically viable on a large scale. The development of new materials with unique properties, such as ZnO, graphene, and their mixing ratios, is used to improve the PSC's efficiency, and these devices are rapidly progressing to achieve maximum efficiency. Now researchers are trying to develop PSC devices for commercialization with easy processing and mass production in the market. Advanced materials (e.g., TiO_2 and mediated nanoparticles) are used for environmental remediation (adsorption, photocatalysis, filtration, etc.) and contaminant treatment (such as heavy metals, dyes, chlorinated and volatile compounds). Although the potential uses of the advanced materials mentioned above are inherently unstable under normal conditions, their synthesis requires special tools for the formulation of nanomaterials at the nanoscale, whereas the limitation of their use in the remediation process is costly due to the toxicity of nanoparticles (especially metallic ones) and byproducts. Advanced materials, including biomaterials, perovskites, and artificial silk, are some tailored materials with innovative properties that are or will be commercially available for potential use in future advanced applications.

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Dr. Indra Prabha Jain is a Professor and the Founder Director of the Centre for Non-Conventional Energy Resources (CNER), University of Rajasthan, Jaipur, Rajasthan, India, and has been listed among the world's top 2% scientists by Stanford University published in October 2020 to continue till now. Prof. Jain established various equipment facilities at the Centre for the Materials Science especially for hydrogen storage and thin film facility. He has been awarded the prestigious SIDA (Sweden) Fellowship with Nobel Laureate Prof. Kai. Siegbahn, Commonwealth Fellowship, Emeritus Scientist by CSIR and UGC, Govt. of India. Prof. Jain published more than 180 research papers on high-impact factors (more than 60 papers in *SCI Journals on Hydrogen Energy*). He has supervised 25 Ph.D. in his tenure and organized many international and prestigious conferences at UOR. He has many keynote/plenary speeches, invited talks, chairing sessions, and organizing sessions at international conferences in various countries. He was a guest editor of IJHE 2008 and 2012.