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Editorial

Nanomaterials for Renewable Energy Storage: Synthesis, Characterization, and Applications

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Nanotechnology and nanoscale materials have been part of human history and in use since centuries. Staining of glass windows hundreds of years ago is one of the examples where people created beautiful works without knowing that they are using nanoprocessing. The beginning of modern era of nanotechnology dates back to the talk of the Nobel laureate Professor Richard Feynman in "There's plenty of room at the bottom." Professor Feynman hypothesized that in near future scientists would be able to control and modulate individual molecules and atoms. After a decade, Professor Norio Taniguchi introduced the magical word "nanotechnology." However, in 1981, the introduction of scanning tunnelling microscope enabled the scientists to see the materials in nanoscale that propagated the new age of nanotechnology.

In the quest for finding smaller, low cost, and efficient materials, scientists were able to gradually develop improved products where nanotechnology has at least contributed partially. Today, knowingly or unknowingly nanotechnology has become part of basic research at the laboratory scale with some success in practical application. Carbon in its various forms such as carbon nanotubes (CNTs), fullerenes, and graphene has contributed drastically in this journey. Metal-doped CNT provides high hydrogen storage capacity due to spillover phenomenon. Nanomaterials, such as inorganic metal oxides, have enjoyed their market share in various fields including the energy storage and production, sensors, medicine, additives, electronics, and many more. Nanomaterials in combination with polymeric materials have promoted the study of a new series of materials called nanocomposites or hybrid materials in which the properties of nanomaterial decide the fate of the final product. Such an approach guaranteed the applicability of each constituent where individual contribution might not be sufficient. This upsurge was possible only through the development of process engineering where the industrial adaptability was guaranteed. However, a complete revolution by nanotechnology is only possible if we appropriately address the issues and challenges related to large-scale manufacturing and health hazards. Various kinds of characterization techniques play vital role in exploring the nanoscale size properties of different kinds of materials synthesized.

In a lone review article submitted to special issue by R. Zacharia and S. Rather, they presented the review of solid state hydrogen uptake methods using different kinds of innovative materials such as metallic and intermetallic hydrides, complex chemical hydride, nanostructured carbon materials, metal-doped carbon nanotubes, metal-organic frameworks (MOFs), metal-doped metal-organic frameworks, covalent organic frameworks (COFs), and clathrates. The review provides insight about the deficiencies of current energy economy and discusses various steps of implementation of hydrogen energy based economy. The review articles were divided into two parts. In the first part, current status of fossil-fuel based energy economy was highlighted and it was found that, to use hydrogen as a fuel in the future especially in transportation context, it is important to improve the hydrogen storage methods. In the second part novel solid state hydrogen storage techniques engaging above materials are presented. M. Zain-ul-abdein et al. reported that composite materials for thermal applications can propose broad range of properties that depend upon factors such as volume fraction of the matrix and filler, shape morphology, particle size, and interfacial thermal resistance that limits the effective properties of the medium. Furthermore, properties of interface zone play an important role in limiting the behavior of composite material within the limits of both micro- and nanosystems. Micron size contribution inclusions are less affected by the interface area due to very small interface thickness to inclusion radius ratio as compared to nanoparticles. T. Liu et al. reported that Ru@MIL-101 was prepared by double solvents method (DSM) and treated as catalyst for hydrolysis of ammonia borane. Ru nanoparticles were successfully embedded inside the cavities of metallic organic framework MIL-101 and avoided the deposition of Ru nanoparticles on the outer surface of MIL-101 confirmed by HRTEM and were characterized by XRD, N_2 adsorption/desorption, and ICP-AES. It was found that Ru@MIL-101 catalyst shows high activity and selectivity as well as good durability for hydrolysis of ammonia borane for hydrogen generation. M. Tian and C. Shang presented that nanostructured carbon was prepared by methane cracking and further treatment was followed to enhance porosity. As-synthesized samples were characterized by BET SSA, Raman spectra, and TEM. The as-synthesized carbon after further treatment considered here as modified sample shows high BET surface area/pore size. Furthermore, modified carbon also shows high CO_2 adsorption at room temperature as compared to commercial activated carbon.

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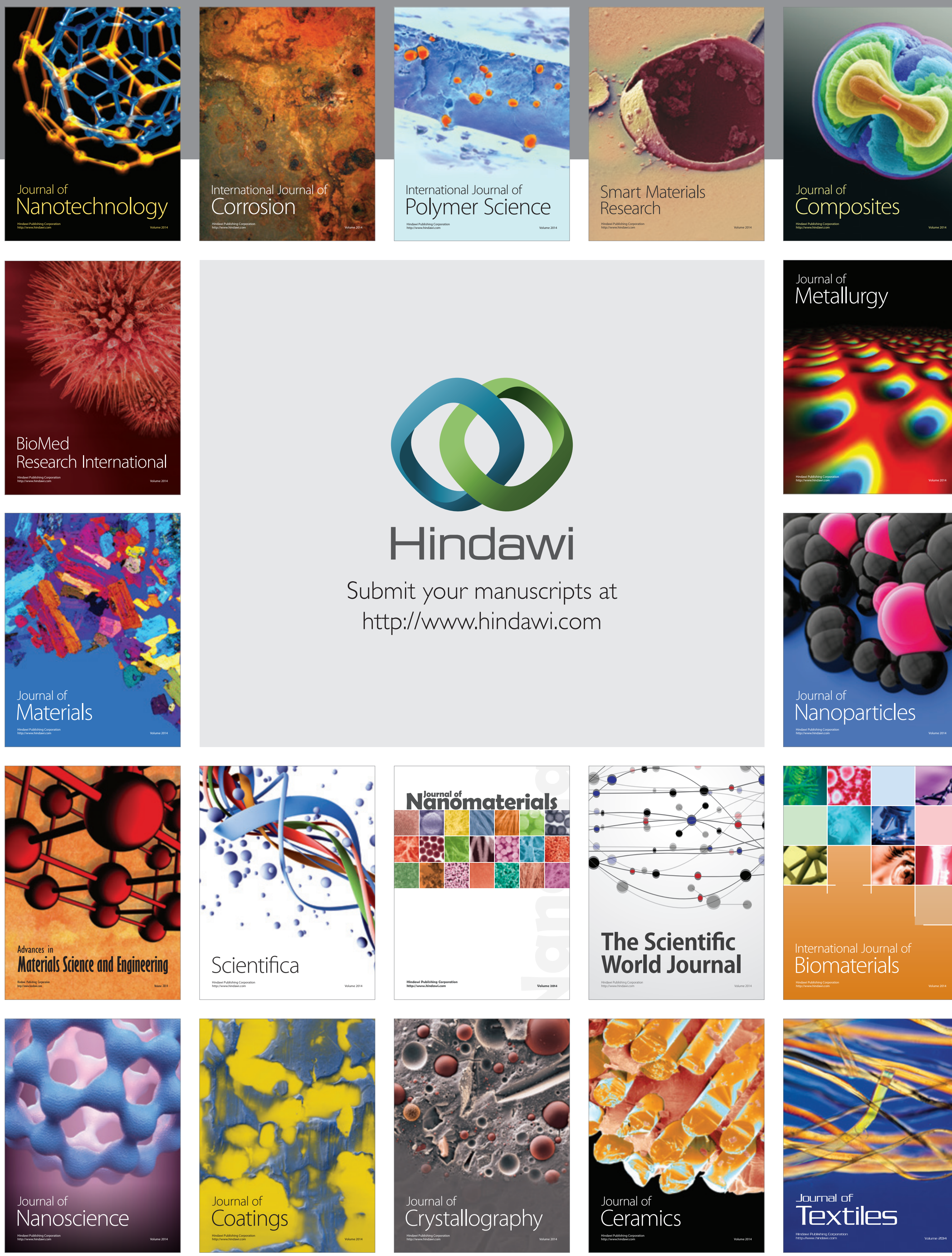
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