PERSPECTIVE

Environmental and energy applications of nanocomposites

Emanuel Ungaro

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ABSTRACT

Carbon nanotube and graphene-attached composite materials have been touted as attractive candidates. Because of their remarkable structural dimensions and great mechanical, electrical, thermal, optical, and chemical properties, carbon nanocomposites have piqued interest in a variety of sectors, including biomedical applications. The significance of recent advances in carbon nanocomposite technology, as well as the discovery of new nanocomposite processing technologies, are discussed toorder to improve the functional impact of nanotube and graphene composites by providing proper synthesis methods and improving the production of diverse composites based on carbon nanomaterials. Aviation, batteries, the chemical industry, fuel cells, optics, power generation, space, solar hydrogen, sensors, and thermoelectric devices are just a few of the applications for carbon nanocomposites. This study delves into the latest design, production, properties, and uses of carbon nanocomposites like active carbon, carbon black, graphene, nanodiamonds, and carbon nanotubes. Vander Waals force interfacial compounds, unlike standard fibre composites, have a significant impact on the mechanical performance of carbon nanomaterial-based composites.

Key Words: *Nanotube; Nanocomposites*

INTRODUCTION

The two major difficulties of the twenty-first century are the environment and energy. Climate change and the energy crises have necessitated the development of long-term and inventive solutions to these problems Among the various existing methodologies, the advent of functional nanocomposites as potential instruments to address environmental and energy-related challenges has gotten interested in a lot of interest in both laboratory research and industrial applications. The combined synergistic effects of a wide spectrum of nanomaterials and their host materials have resulted in exceptional benefits over commonly used materials. Various nanocomposite's remarkable chemical and physical features have unlocked their promise in a variety of practical applications. Nanocomposites are also very interesting in terms of providing long-term answers to global difficulties such as environmental issues and pollution. Carbon-based nanocomposites are a type of functional nanomaterial that can be used to solve environmental problems and produce energy-related gadgets. The dimensional interface of a nanocomposite made of $BiVO_4$ and reduced graphene oxide (rGO). $BiVO_4$ and rGO were synthesized in various dimensions (OD, 1D, and 2D) and linked to produce a heterojunction semiconductor. The maximum visible-light-induced photocatalytic activity toward the breakdown of acetaminophen was obtained when the 2D–2D chemical coupling of $BiVO_4$ and rGO was detected. Dimensional parameters are important in the design of heterojunction photocatalysts, according to the findings. Mesoporous-rich activated polymer-based hard carbon electrodes for use in electrical double-layer capacitors. To get the best electrochemical capacity, several steam activation settings were used to optimize textural features including pore size and pore dispersion.

A simple approach for the large-scale production of low crystalline MoO3/carbon composite microspheres. The MoO_3 nanocrystals were disseminated evenly throughout the amorphous carbon matrix using a one-step spray pyrolysis process. Because of their superior structural stability and electrical conductivity, the MoO_3/carbon composite microspheres achieved higher Li-ion storage than MoO_3. To get the best electrochemical capacity, the steam activation settings were changed to optimize textural features including pore size and pore dispersion. The effectiveness of Cu (II) ion removal, specific capacity, and cycling stability were all examined. Silica-coated magnetic nanoparticles were chemically functionalized with amino-rich Polyethyleneimine (PEI) and employed as nano adsorbents for Cu (II) ion removal. The role of PEI in improving nano adsorbents' performance was discussed. The reusability and ease of recycling of nano adsorbents were emphasized as key characteristics for practical applications in the treatment of heavy metal-contaminated sludge, with polystyrene colloidal particles and GO serving as a sacrificial template and reinforcing filler, respectively. An aerogel with porous calcium alginate and GO. Through ion exchange and chemical coordination mechanisms, the nanocomposite showed a high adsorption capability towards Pb (II), Cu (II), and Cd (II) ions. To improve photocatalytic activity, Titania Nanoparticles (TiO_2) into the 3D crossing area of stacked plasmonic Ag nanowires. The Ag nanowires–TiO_2 interface provided excellent hot electron transport in this nanocomposite, whereas the Ag nanowires–TiO_2 contact provided high localized surface plasmon resonance excitation. The hybrid material's photocatalytic performance was strong across the ultraviolet and visible light spectral bands due to the synergistic effects.

Editorial office, Journal of Nanoscience and Nanomedicine, United Kingdom

Correspondence: Ungaro E, Editorial Office, Journal of Nanoscience and Nanomedicine, United Kingdom; E-mail: Nanomedsci@medicalres.org

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The two review articles are gathered in this Special Issue. The former offered light on the roles of nanomaterials in both established and developing heavy metal removal technologies. This review discusses the fascinating properties of nanomaterials and their hybrids, as well as production methodologies and removal concepts. Different heavy metal removal processes employing new nanocomposites are discussed discussed, including adsorption, filtration, and oxidation.

In the second mini-review, various in situ synthesis techniques for SiC materials utilized in lithium-ion batteries are discussed. Due to the growing adoption of SiC materials for the development of lithium-ion batteries due to their outstanding lithium-ion intercalation capacity and cycle stability, this review examines current developments in the preparation of SiC materials as well as future research directions.