Journal of Thermodynamics and Catalysis
ISSN: 2157-7544
OPEN ACCESS Freely available online
Perspective

Functional Nanomaterials by a Variety of Structural Factors

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DESCRIPTION

Nanomaterial-based catalysts are frequently heterogeneous catalysts which have been broken into metal nanoparticles to optimise the catalytic process. Catalytic activity can be increased by using metal nanoparticles with a wide surface area. Nanoparticle catalysts are simple to separate and recycle. They are generally employed in moderate circumstances to avoid nanoparticle breakdown. Due to the general readily accessible number of atoms on surfaces, nanotechnology has a substantial impact on increasing catalytic efficiency due to its high surface area to volume ratio, which allows nanoscale catalysts to interact better with reactants. Water filtration, biofuel, power storage, composite solid rocket propellants, bio diesel synthesis, medicines, and dyes are the most common applications for nanocatalysts. Carbon nanotube applications and various more points of application are described in depth here.

Pesticides and chemical substances produced as a result of fast industrialisation and pharmaceutical businesses constitute a significant environmental concern. New photocatalysts based on zinc oxide and titanium oxide show tremendous promise for absorbing organic contaminants from wastewater. Photocatalysts have unique qualities such as photocatalytic degradation potential, non-toxicity, and high stability. Nevertheless, there are various difficulties connected with the use of these photocatalysts, such as weak affinity, particle aggregation, a high band gap, and recovery concerns.

As a result, optimisation is essential to improve their productivity while also making them cost effective and sustainable. The review discusses the water treatment process, constraints, and development of various modification techniques to increase the removal efficiency of titanium and zinc oxide based photocatalysts. As a result, more research into photocatalysts for water remediation might be promoted.

The rapid growth of the associated energy and catalysis sectors, which is emerging as one of the hottest and fastest-growing issues, is triggered by the increasing need for sustainable and clean energy. A lot of work has gone into improving the energy storage and conversion efficiency of hydrogen energy generation, fuel cells, lithium batteries, and so on, facilitating the transfer of these technologies from basic research to industrial applications. The rapid development of functional nanomaterials offers significant opportunity to achieve this objective. Many strategies for manipulating the fine structure of traditional materials or even discovering new materials have been developed. Intermetallic compounds (or ordered nanoalloys), high-entropy nanoalloys or oxides, single-atom (or atomically distributed) catalysts, and other nanomaterials with adjustable characteristics are developing.

CONCLUSION

Because of their superior catalytic performance and higher utilisation rate of precious metals, Single-Atom Catalysts (SACs) have been widely used in the Hydrogen Evolution/Oxidation Reaction (HER/HOR) and Oxygen Evolution/Reduction Reaction (OER/ORR), which are the main catalytic processes for hydrogen energy production *via* water electrolysis and fuel cells. Furthermore, because SACs have more uniform structures and local coordination settings, they are evolving into model systems that may bridge experimental and theoretical investigations to advance basic understandings. The researchers are still finding it difficult to tailor catalysts or electrode materials at the atomic level to the needs of a certain process or device. Moreover, the characteristics of these functional nanomaterials are determined by a variety of structural factors such as composition, size, crystallographic structure, morphology, oxidation state, and so on. It is extremely difficult to accurately adjust only one parameter while leaving other settings untouched, which may result in unanticipated property or performance changes. Meanwhile, many of the procedures utilised to manufacture effective energy nanoparticles are exceedingly intricate (or expensive) and impossible to perform on an industrial scale.

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Received: 01-Jan-2023, Manuscript No. JTC-23-23468; **Editor assigned:** 03-Jan-2023, PreQC No. JTC-23-23468 (PQ); **Reviewed:** 17-Jan-2023, QC No. JTC-23-23468; **Revised:** 24-Jan-2023, Manuscript No. JTC-23-23468 (R); **Published:** 31-Jan-2023, DOI: 10.35248/2157-7544.23.14.320

Citation: Yang C (2023) Functional Nanomaterials by a Variety of Structural Factors. J Thermodyn Catal. 14:320.