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Editorial

Editorial: Special Issue on "Emerging Nanostructured Catalytic Materials for Energy and Environmental Applications"

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In recent years, there has been a great demand for the rational design and development of novel catalytic materials at the nanoscale (1–100 nm), with a view to more accurately and efficiently control reaction pathways due to their high surface area and intrinsic properties. The development of next-generation nanostructured catalytic materials (NCM) relies on novel synthetic approaches, which can be suitable to produce stable surface-active sites through controlling the size, shape, and chemical composition and surface characterization techniques that can determine catalytic activities.

The advances in NCM in recent years envisage a new vision for nanoscience-inspired design, synthesis, and formulation with high activities for energetically challenging reactions, high selectivity to valuable products, extended lifetimes, and recyclability, leading to the production of industrially important catalytic materials. Success has been achieved to a great extent, but the exploration of developing new NCM through the precise control of the composition and structure of the materials (metals, metal oxides, polymers, alloys, composites, hybrids, etc.) of choice is continuing [1]. Tremendous efforts are being made to design innovative catalysts that can be utilized in a multitude of applications [2]. The implications of further progress in the development of emerging advanced nanostructures and their applications in the areas of energy, sensing, and the environment are profound.

In this Special Issue, we have captured some of the latest progress and newest scientific advancements in emerging NCM (1 review [3] and 11 original articles) to understand the ongoing issues and challenges focusing on various aspects of catalytic materials. Three articles have been flagged as a "Feature Paper" by the Editorial Board, following recommendations from the reviewers [4–6]. The important contributions are summarized here.

E. Kowsari et al. reported an efficient hybrid composite based on polyionic liquid PIL@TiO_2/m-GO and evaluated the photocatalytic degradation of gaseous benzene and toluene [4]. Similarly, a group of researchers led by H. Deng et al. developed a visible light assisted photocatalyst utilizing a reduced graphene oxide/$ZnIn_2S$ (rGO/ZIS) through a facile one-pot hydrothermal method and studied the photocatalytic efficacy for the degradation of naproxen under visible light irradiation [7]. Different from the other reports, H. Zhang et al. investigated photocatalytic activities of polyethylene terephthalate (PET) filaments deposited with N-doped Titanium dioxide (TiO_2) nanoparticles sensitized with water-insoluble disperse blue SE–2R dye and compared the activity of a model compound, methylene blue [8]. Y. Lu et al. utilized controllable morphological metal-based catalytic materials through the facile synthesis of porous hexapod Ag@AgCl bi-functional catalysts for in-situ surface-enhanced Raman spectroscopy (SERS) to monitor the reduction of 4-Nitrothiophenol [9].

In a particular work conducted by Pere L. Cabot et al., bimetallic electrocatalysts (PtNi) were sequentially synthesized through electroless deposition on nickel, and their

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bifunctional attributes for carbon monoxide and methanol oxidation reaction (MOR) in low-temperature fuel cells were evaluated. Similarly, a new kind of Pt supported amorphous barium aluminum oxide/conductive carbon (Vulcan XC-72) catalyst was prepared (polyol thermal method) and analyzed the electrocatalytic activity for MOR. Among the investigated samples, Pt-$Ba_{0.5}AlO_x$/C with 20% loadings of Pt exhibited a maximum current density of 3.89 mA/cm^2 and enhanced electrochemical surface area of 49.83 m^2/g due to the combined effects of individual active components [10].

In another work, the photodegradation of gas-phase benzene through SnO_2 nanoparticles (a humidity-tolerant photocatalyst) by a direct hole oxidation mechanism has been studied in humid air, dry air, and N_2 by using a tubular photoreactor [11]. The mechanisms have been analyzed based on the experimental findings. An efficient photocatalytic hydrogen peroxide production (H_2O_2) over TiO_2 passivated by SnO_2 was developed by V.A.L.Roy et al. through the inclusion of a gold co-catalyst to further boost the production of H_2O_2 [12]. In another work, the facile fabrication of metal oxide dispersed catalytic electrodes by AC plasma deposition and electrochemical detection of H_2O_2 [1]. The as-prepared catalytic electrode (CuO NPs) exhibited superior analytical characteristics (low detection limit, good sensitivity/selectivity, and rapid response) for H_2O_2 sensing.

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