Perspective

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The Development of Polymer Nano-Photocatalysts in the Future

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Description

Due to their adaptable pore apertures, appealing chemical properties, and excellent stability, fluorinated metal–organic frameworks (F-MOFs) as rapidly growing porous materials have revolutionized the field of gas separation. For the synthesis and creation of new F-MOFs, a thorough comprehension of their structure–performance relationships is necessary. This critical review has focused on a number of methods for precisely designing and synthesizing brand-new F-MOFs with structures designed specifically for gas separation. First, the structure, synthesis, and modification of F-MOFs, as well as their structure-to-property relationships, are investigated. Then, we talk about how F-MOFs can be used in adsorption and membrane gas separation. The underlying principles and the design of F-MOFs for the adsorption of various gases are explained in great detail. To make selective membranes for gas separation, the exceptional properties of highly stable F-MOFs with engineered pore sizes and tuned structures are also taken into account. F-MOFs are standard materials in the majority of challenging gas separations, according to systematic analysis of their position in that process.

Catalytic Properties

To address the issues of overcoming the trade-off between capacity/permeability and selectivity for a serious move toward industrialization, the perspectives, future directions, and obstacles of F-MOFs are highlighted. As a traditional heterogeneous catalyst, platinum nanoparticles (Pt NPs) have a long history. Additionally, Pt has traditionally been included in organometallic chemotherapy drug formulations .Due to its outstanding catalytic properties, however, a new role in cancer therapy is emerging, allowing for the exploration of novel strategies in this review. Pt NPs as catalysts capable of modifying key processes that are taking place in the Tumor Microenvironment (TME) are the topic of this critical discussion and attempt to determine future perspectives. In addition, we investigate relevant parameters that influence Pt nanosystems' cytotoxicity, biodistribution, and clearance.Co-catalysts, external energy sources (near-infrared light, X-ray, electric currents), and conventional therapies are among the potential synergies that could result from combining Pt's catalytic capabilities with other agents. In addition, we investigate the benefits and drawbacks of biocompatibility.

It is thought that using photocatalytic reactions to make renewable fuels from solar energy and abundant resources like water and carbon dioxide could be a good way to adequately address the problem of climate change. One way to convert solar energy into hydrogen and other solar fuels is through photocatalytic systems made up of organic polymer nanoparticles (PNPs).Semiconducting PNPs are light-harvesting materials that perform better than conventional organic dyes and inorganic semiconductors due to their superior optical properties, photostability, low cost, and low cytotoxicity. The cocatalyst loading and morphology tuning optimization strategies for PNP preparation methods are discussed in this overview. The physico-chemical properties of these materials, as well as their catalytic activity, will be affected in a variety of ways by the preparative methods that we examine. For the purpose of characterizing the physicochemical properties (optical, morphological, electrochemical, and catalytic properties) of PNPs, a list of experimental methods is provided. With a focus on the mechanistic understanding of the processes of internal charge generation and transport to the catalyst, we provide a comprehensive analysis of PNP photochemistry during photocatalysis. This tutorial review provides the reader with guidelines on the strategies that are currently used to improve PNP performance and focuses on the development of polymer nano-photocatalysts in the future.

Photocatalytic Transformation

Over the past two decades, there has been a growing interest in peptide self-assemblies because of their intriguing and tunable physicochemical properties. However, the self-assemblies' micro- and nano-scale dimensions severely limit their application range. Inspired by nature, it is beneficial to further organize the peptide self-assemblies to integrate the properties of the individual supermolecules and fabricate higher-level organizations for smart functional devices in order to truly realize the practical application of bio-organic super-architectures. Peptide microfabrication has therefore been the subject of numerous studies that have produced a variety of properties. This review provides a synopsis of the most recent advancements in the microfabrication of peptide self-assemblies. It also discusses each method, as well as the various properties and practical applications of engineered peptide large-scale, highly-ordered organizations. Last but not least, a critical evaluation of the limitations that the most cutting-edge microfabrication methods currently have is conducted, and various alternate solutions are offered. The need for renewable, clean, and environmentally friendly energy sources is unquestionably urgent due to the rising energy demand and environmental issues brought on by fossil fuel overexploitation. When produced photocatalytically from water, the zero-emission energy carrier H2 is an ideal alternative to carbon-based fuels. In addition, the photocatalytic transformation of CO_2 into chemical fuels has the potential to cut CO_2 emissions and benefit both the environment and the economy. Numerous artificial photocatalytic strategies based on porphyrinoids have been studied, inspired by natural photosynthesis. The most recent developments in porphyrin or phthalocyanine derivative photocatalytic H_2 production and CO_2 reduction systems are discussed in this review. Porphyrinoids can be used as catalysts and chromophores due to their unique properties. The various methods for increasing photosensitizing activity and catalytic performance at the molecular level are presented in the initial description of homogeneous photocatalytic systems. On the other hand, a variety of approaches, such as self-assembled supramolecular porphyrinoid nanostructures, organic framework construction, combination with two-dimensional materials, and adsorption onto semiconductors, were utilized for the creation of the heterogeneous systems. Molecular-based Dye-Sensitized Photoelectrochemical Cells (DSPECs) based on porphyrins and phthalocyanines were made possible by dye sensitization on semiconductors. The research on photocatalytic systems that has been discussed here continues to be challenging due to the numerous limitations that prevent them from being used in a large-scale application before finding one.