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Современные представления о механизме реакции восстановления кислорода на металл-несодержащих гетероатом-допированных углеродных наноструктурах на основе квантово-химических расчетов

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Laser deposition methods to develop new sensor and catalytic nanomaterials **RCR5203**

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This review is devoted to an important part of the chemistry of nanomaterials synthesized by laser deposition methods. The structural and composition features of these nanomaterials formed the key trend of research in this field: catalytic and sensing properties. This is not the only application where these materials show promise, but it is undoubtedly the most important one. Until very recently, research in this area was the preserve of specialists in laser physics, electronic and semiconductor technology, and nonlinear optics. The goal of this review is to partially fill the information gap and discuss the role of chemical factors that enable the preparation of nanomaterials with high catalytic and sensing properties. This will enable interested researchers to optimize the laser synthesis processes by deliberately selecting the composition of the starting materials and precursors relying on the information on possible phase compositions and crystallographic characteristics. The discussion of the chemical aspects of laser synthesis is preceded by a brief description of the fundamentals of pulsed laser deposition (PLD) method and laser-induced chemical liquid-phase deposition (LCLD) of metals from solutions. The description is focused on the formation of the phase structure of nanoparticles and nanofilms, which determines their sensing and catalytic properties. The prospects of using laser deposition processes for the design of nanomaterials for hydrogen energy, medicine, organic and inorganic catalysis, and ecology are also analyzed.

Bibliography — 219 references.

Metal sulfide quantum dots for photothermal and photodynamic cancer therapy **RCR5208**

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Cancer remains a leading cause of global mortality, highlighting the urgent need for safe and effective therapeutic strategies. Photothermal therapy (PTT) and photodynamic therapy (PDT) have emerged as promising approaches for tumour treatment. Quantum dots (QDs), semiconductor nanocrystals with unique quantum effects, offer significant potential in these therapies. Among them, metal sulfide quantum dots (MS QDs), with particle sizes ranging from 1 to 10 nm, stand out due to their excellent fluorescence, chemical stability, photophysical properties, and biocompatibility. These attributes make MS QDs particularly suitable for combined PTT/PDT in cancer therapy. This review systematically discusses the synthesis methods of MS QDs and highlights recent advancements in their application for PTT/PDT combination therapy. Finally, we provide perspectives on the future development of MS QDs in phototherapeutic applications.

Bibliography — 275 references.

Chemical recycling of plastic waste: polyacrylonitrile and its copolymers. A review **RCR5211**

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The proportion of waste electrical and electronic equipment is increasing year by year. This phenomenon is driven by the economic development and growing consumption. Acrylonitrile–butadiene–styrene copolymers represent a substantial constituent of electronic and household appliance waste. Butadienenitrile rubber and polyacrylonitrile are also classified as high-tonnage products. The waste from these polymers share the presence of a nitrile moiety in the macromolecules and the impossibility of selective solvolysis/hydrolysis to obtain monomers, as in the case of polyethylene terephthalate, polyamides, and polyimides. The chemical recycling of acrylonitrile copolymers is

frequently rendered more complex by the presence of brominated flame retardants and synergists and therefore the elevated levels of nitrogen and bromine compounds present in the products. The review methodically analyzes the chemical recycling of polyacrylonitrile and its copolymers, including hydrolysis, hydrothermal recycling, gasification, and pyrolysis. The primary focus of this study is on brominated waste, which poses significant challenges in terms of reuse without undergoing chemical recycling. In contrast to previous review publications, the present study provides comprehensive analysis of the hydrocarbon composition of polymer conversion products and the content of nitrogen- and bromine-containing organic compounds. The potential for the further refining of pyrolysis products to yield not only fuels but also high value-added products, such as monomers, is considered separately. The potential of methods for preliminary preparation of polymer waste for recycling including hydrolysis and hydrothermal treatment, which have not received sufficient attention previously, is demonstrated.

Bibliography — 182 references.

Modern views on the mechanism of oxygen reduction reaction on metal-free heteroatom-doped carbon nanostructures. Quantum chemical approach

RCR5214

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This review summarizes the modern views on the mechanism, active site structure, and thermodynamics of the electrochemical oxygen reduction reaction catalyzed by heteroatom-doped carbon nanostructures for the subsequent rational design of catalytic sites and development of promising metal-free cathode materials for fuel cells for next-generation energy systems. The effect of both classic (B, N, S, P, O, Hal) and advanced ‘hybrid’ (Si, Se) dopants in various states and in two- or threecomponent forms on the activity modulation of oxygen adsorption sites and on the reaction mechanism is considered. Particular attention is paid to the evolution of the views on the role of silicon, which switched from considering silicon to be inert due to its high oxophilicity to the discovery of unique catalytic properties of silicon in SiN_x type catalytic sites. The conclusions made in the review open up new opportunities for the targeted design of hierarchical materials with adjustable properties *via* precise control of the composition and structure of heteroatom defects.

Bibliography — 252 references.

