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Hard carbon as anode material for metal-ion batteries

RCR5100

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The development of large-scale energy storage systems based on the mature technology of lithium-ion batteries is hampered by the high cost of lithium. Therefore, analogous technologies based on other alkali metals (sodium and potassium) are being developed. Among various types of negative electrode (anode) materials for such batteries, carbon materials are most promising; in particular, hard carbon is of most interest. The present review addresses the current state of research on the structure, composition and properties of this type of material and gives analysis of methods of its preparation and investigation. Description of the microstructure of hard carbon is a highly ambiguous and challenging problem; therefore, the review pays special attention to various microstructural models. In addition, the methods of synthesis are systematized and the results of studies of the physicochemical properties of hard carbon are analyzed. The correlations between the preparation method, characteristics and electrochemical properties in metal-ion batteries are identified. A large array of results of electrochemical studies is considered, the views on the mechanisms of electrochemical interactions of Na⁺ and K⁺ cations with hard carbon are systematized, and the currently existing contradictions in various models of the interaction mechanisms are shown. Bibliography — 247 references.

Energetic 1,2,4-oxadiazoles: synthesis and properties

RCR5109

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The study of high-energy materials based on poly nitrogen- and nitrogen-oxygen-containing heterocycles is one of the most important and relevant modern interdisciplinary research areas at the intersection of organic and physical chemistry and materials science. Among such heterocycles, 1,2,4-oxadiazole ring is a rather interesting building block for the synthesis of new energetic compounds. Although the chemistry of 1,2,4-oxadiazoles has been developed for more than 100 years, high-energy materials based on these heterocycles have only recently become known and are currently one of the 'hot spots' in this field of science. This review systematizes recently published methods for the synthesis and features of the reactivity of 1,2,4-oxadiazole-based energetic compounds. Mono- and bis(1,2,4-oxadiazoles) as well as structures containing other azoles such as pyrazole, 1,2,5-oxadiazole, 1,3,4-oxadiazole, 1,2,3-triazole, 1,2,4-triazole and tetrazole are considered. For the series of structurally similar compounds, their physicochemical properties are summarized and the factors affecting a particular parameter are discussed.

Bibliography — 123 references.

From epoxides and carbon dioxide to polycarbonates: synthesis, properties and applications

RCR5112

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Carbon dioxide (CO₂) plays a vital role in organic and polymer chemistry as a source of cheap and available raw material for the synthesis of many valuable products, including polymer materials with a specified set of properties, and as a solvent for chemical reactions. This review is devoted to the synthesis, properties and applications of polycarbonates obtained by copolymerization of CO₂ with epoxides, a hot topic that has aroused great interest among the scientific community and industry representatives. The existing data on the catalytic systems used for the synthesis of polycarbonates are analyzed and summarized, depolymerization of polycarbonates, which is a key aspect in the polymer recycling, is discussed, information on the properties and applications of polycarbonates is systematized, and prospects for the development of this area of chemistry are considered.

Bibliography — 438 references.