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# Precursor Synthesis of Carbon Materials with Different Aggregates Morphologies

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**Abstract :** Carbon materials with advanced surfaces are widely used both in modern industry and in environmental protection. The physical-chemical nature of these materials is determined by the morphology of primary atomic and molecular carbon structures, which are the basis for synthesizing the following materials: zero-dimensional (fullerenes), one-dimensional (fiber, tubes), two-dimensional (graphene) carbon nanostructures, three-dimensional (multi-layer graphene, graphite, foams) with unique physical-chemical and functional properties. Experience shows that the microscopic morphological level is the basis for the creation of the next mesoscopic morphological level. The dependence of the morphology on the chemical way and process prehistory (crystallization, colloids formation, liquid crystal state and other) is the peculiarity of the last called level. These factors determine the consumer properties of carbon materials, such as specific surface area, porosity, chemical resistance in corrosive environments, catalytic and adsorption activities. Based on the developed ideology of thin precursor synthesis, the authors discuss one of the approaches of the porosity control of carbon-containing materials with a given aggregates morphology. The low-temperature thermolysis of precursors in a gas environment of a given composition is the basis of the above-mentioned idea. The processes of carbothermic precursor synthesis of two different compounds: tungsten carbide WC:nC and zinc oxide ZnO:nC containing an impurity phase in the form of free carbon were selected as subjects of the research. In the first case, the transition metal (tungsten) forming carbides was the object of the synthesis. In the second case, there was selected zinc that does not form carbides. The synthesis of both kinds of transition metals compounds was conducted by the method of precursor carbothermic synthesis from the organic solution. ZnO:nC composites were obtained by thermolysis of succinate Zn(OO(CH2)2OO), formate glycolate Zn(HCOO)(OCH2CH2O)1/2, glycerolate Zn(OCH2CHOCH2OH), and tartrate Zn(OOCCH(OH)CH(OH)COO). WC:nC composite was synthesized from ammonium paratungstate and glycerol. In all cases, carbon structures that are specific for diamond- like carbon forms appeared on the surface of WC and ZnO particles after the heat treatment. Tungsten carbide and zinc oxide were removed from the composites by selective chemical dissolution preserving the amorphous carbon phase. This work presents the results of investigating WC:nC and ZnO:nC composites and carbon nanopowders with tubular, tape, plate and onion morphologies of aggregates that are separated by chemical dissolution of WC and ZnO from the composites by the following methods: SEM, TEM, XPA, Raman spectroscopy, and BET. The connection between the carbon morphology under the conditions of synthesis and chemical nature of the precursor and the possibility of regulation of the morphology with the specific surface area up to 1700-2000 m2/g of carbon-structured materials are discussed.

**Keywords :** carbon morphology, composite materials, precursor synthesis, tungsten carbide, zinc oxide
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