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Chemical Technology Approach for Obtaining Carbon Structures Containing Reinforced Ceramic Materials Based on Alumina

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Abstract : The growing scientific-technological progress in modern civilization causes actuality of producing construction materials which can successfully work in conditions of high temperature, radiation, pressure, speed, and chemically aggressive environment. Such extreme conditions can withstand very few types of materials and among them, ceramic materials are in the first place. Corundum ceramics is the most useful material for creation of constructive nodes and products of various purposes for its low cost, easy accessibility to raw materials and good combination of physical-chemical properties. However, ceramic composite materials have one disadvantage; they are less plastics and have lower toughness. In order to increase the plasticity, the ceramics are reinforced by various dopants, that reduces the growth of the cracks. It is shown, that adding of even small amount of carbon fibers and carbon nanotubes (CNT) as reinforcing material significantly improves mechanical properties of the products, keeping at the same time advantages of alundum ceramics. Graphene in composite material acts in the same way as inorganic dopants (MgO, ZrO2, SiC and others) and performs the role of aluminum oxide inhibitor, as it creates shell, that gives possibility to reduce sintering temperature and at the same time it acts as damper, because scattering of a shock wave takes place on carbon structures. Application of different structural modification of carbon (graphene, nanotube and others) as reinforced material, gives possibility to create multi-purpose highly requested composite materials based on alundum ceramics. In the present work offers simplified technology for obtaining of aluminum oxide ceramics, reinforced with carbon nanostructures, during which chemical modification with doping carbon nanostructures will be implemented in the process of synthesis of final powdery composite – Alumina. In charge doping carbon nanostructures connected to matrix substance with C-O-Al bonds, that provide their homogeneous spatial distribution. In ceramic obtained as a result of consolidation of such powders carbon fragments equally distributed in the entire matrix of aluminum oxide, that cause increase of bending strength and crack-resistance. The proposed way to prepare the charge simplifies the technological process, decreases energy consumption, synthesis duration and therefore requires less financial expenses. In the implementation of this work, modern instrumental methods were used: electronic and optical microscopy, X-ray structural and granulometric analysis, UV, IR, and Raman spectroscopy.

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