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COMPACTING OF NANOSTRUCTURED CARBON MATERIALS: CHEMICAL AND PHYSICAL APPROACHES

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Abstract

Nanoscale carbon structures, being quite new class of materials, demonstrate wide perspectives to be used in various areas of power, chemical and metallurgical industry as well as electronics. It is caused by variety of their chemical and physical properties together with possibility to influence on them by different types of treatment. For most applications, especially for energy storage: batteries and supercapacitors, carbon nanomaterials must have ppm level of impurities and be compacted to maximal density. Nevertheless such properties as high specific surface area, electroconductivity, mesoporosity, heteroatoms content must be kept. For these purposes spark plasma sintering technique which is widely used in metallurgy and ceramic industry might be an excellent solution. Being simple in practical realization, providing high vacuum level and inert gas filling during sintering, SPS technique allow to compact carbon materials up to 2.0 g/cm^3 density, remove any functional groups from surface of nanotubes and flakes, decrease of defects amount. Present work considers the change of porosity and density of the compacted samples on the condition of sintering and the nature of the material. Different experimental approaches to the treatment of the started carbon nanosized forms for metal nanoparticles and functional groups removal are described. High importance of these factors for application of sintered materials in non-aqueous supercapacitors electrodes is shown and discussed.

As reference approaches the chemical ways of compacting of carbon nanomaterials were utilized. Their value for obtaining of the 3D networks within the bulk samples is demonstrated, what is important for design of metal nanoparticles decorated carbon nanotubes. It takes place due to carbon atoms with uncompensated valences connection via C-C or C-O- bonds when reacted with divynilsulphone. This way opens the wide perspectives of obtaining new composite materials based on uniformly decorated by metals and oxides structured carbon forms.