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Aerogels Based on Graphene Oxide with Addition of Carbon Nanotubes: Synthesis and Properties

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Abstract

Nowadays numerous sorbents based on graphene and other carbon nanomaterials have been synthesized for the removal or collecting of oil remains due to its unique physico-chemical properties. Obtaining of aerogels based on graphene oxide and carbon nanotubes with addition of chitosan solution as a binder component is shown in this paper. Aerogels were synthesized by reduction of aqueous dispersion of graphene oxide using the reducing agents, followed by ultrasonic and thermal treatment. Ultrasound destroys the graphene layers, decreasing them in size, thereby exposing new layers to form edges that already have no stabilizing carboxyl groups, which are located at the edges, and participate in the formation of bonds. The surface morphology of obtained aerogels was studied by SEM. The study of the sorption capacity showed that graphene/CNTs aerogel is characterized by short absorption time and high sorption ability that depend on densities of the used solvents. All experimental results show the possibility of using the aerogels based on graphene and CNTs as sorbents for collection of oil residues.

Introduction

Currently in world science there are researches in the field of creation of carbon nano-aerogel using carbon nanomaterials (graphene, nanotubes, activated carbon). This scientific direction is being intensively developed in such countries as the USA, China, and the United Kingdom. For the Republic of Kazakhstan this research area is also important and promising due to large deposits of oil which are situated on Caspian shelf and mining and transportation of oil in some cases can cause oil spills on water and earth. In future these aerogels can be used as a selective reusable sorbent for oil with high sorption properties.

By definition, a gel is a type of colloidal systems, represented as a slurry of liquid particles in a solid phase. The amount of a solid component in a gel is much smaller by volume than a liquid one, gel consists of nanometer-sized particles that contact with each other followed by formation a branched network of chains and sheets continuously penetrating the entire volume of the gel.

The first carbon aerogel was obtained by Professor Pekala using carbonization of resorcinol-formaldehyde (RF) aerogel. In its turn, it is usually regarded as a kind of highly porous amorphous graphite foam. The main idea of obtaining of RF-aerogel was that high temperature pyrolysis(1000-1200 °C) was carried out at high pressure or in the atmosphere of inert gas. In 1996, Hanzawa et al. developed a new approach for obtaining of carbonized RF-aerogel with ultrahigh surface area by activating the carbon skeleton under the influence of carbon dioxide [1].

Synthesis of graphene-based aerogels is one of the new directions in the field of production of carbon aerogels, for the first time they were synthesized by the group of Professor Wang in 2009 [2]. The dispersion of graphene oxide was transformed to graphene aerogel by a jellification process under the influence of ultrasonic waves with subsequent drying and thermal treatment.

The authors [3] stated that graphene aerogels also possess pronounced superhydrophobic properties due to a specific morphology of their surfaces. It

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