The macropores investigation in carbon nanotubes agglomerates

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The scanning electron microscopy (SEM) is the basic method of carbon nanotubes (CNT) geometrical sizes definition. However this method doesn't allow to investigate macroscopical quantities of CNTs and is labor-consuming. There is a method based on nitrogen adsorption at 77 K to define a specific surface area and porosity of CNTs, and there is a certain dependence between these characteristics and the CNTs geometrical sizes. Revealing of this dependence is the purpose of this work.

In this work we investigated sorption properties of various types multi-walled carbon nanotubes (MWNT), produced by method of chemical vapour deposition and method of catalytic pyrolysis of ethanol. The specific surface area and porosity of MWNT samples were defined by nitrogen sorption at 77 K.

It was shown that experimental dependence of MWNT specific surface area on their average diameter can be approximated as inversely proportional [1]. The given approximation is chosen from calculation of CNT specific surface area as relations of the CNT surface area to its weight.

The method of calculation of agglomerates pore volume in CNT as a difference of limiting filling of all pores and filling of internal CNT cavities is offered. The method is based on distinction of limiting pore filling and fillings of CNT channels, and this distinction decreases with growth of CNT diameter. CNT with smaller diameter are inclined to formation of agglomerates the agglomerates pore volume increases with reduction of CNT diameter [2].

It was shown that at constant pressure of ethanol vapour with increase in temperature of CNTs synthesis reduction of a specific surface both specific pore volume and increase in the average pore size of CNTs is observed. It is related to increase of CNT average diameter with growth temperature. At constant growth temperature the increase in a specific surface and reduction of CNT pore volume with increase of pressure of ethanol vapour is observed.

In the work dependences of a specific surface, specific pore volume from average CNT diameter have been investigated. Selection of the models is spent, allowing to find dependence of specific pore volume on the CNT sizes.

[1] K.A. Williams, P.C. Eklund, *Chemical Physics Letters* **320**, 352-358 (2000).
[2] Hou P., Xu S., Ying Z., Yang Q., Liu C., Cheng H., *Carbon* **41**, 2471-2476 (2003). Abstract information.