POSITRON ANNIHILATION IN Qo FULLERITES, CARBON NANOTUBES AND GRAPHITE

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Positron annihilation spectroscopy is known to be an effective and nondestructive tool for the studies of both electron and defect structure of condensed matter [1, 2]. Its application for investigation of carbon phases [3] elucidated a number of structural peculiarities occurring on both an atomic level and nanometer scale. In particular, the results were interpreted in terms that the positron annihilates with electrons in the interstitial sites of fee fullerite lattice and does not penetrate inside the fullerene cage {4, 5].

In present paper, the samples of pyrolitic graphite, C_M fullerite (Сбо content >98,5%), and multiwall carbon nanotubes (about 150 nm in diameter) were studied by means of the angular correlation of annihilation photons (ACAP). The ACAP spectra, N(8), were measured at room temperature and fitted to the sum of medium (MG) and broad (BG) gaussians:

$$N(Q) = G,\exp(-0^2/2o,^2) + G_2\exp(-0^2/2\, o_2^2),$$

where 0 is correlation angle; $G\backslash$, G_z are the intensities and $o\backslash$, $<7_2$are standard deviations of the gaussians. Shown in the Table are the probabilities, Si and S_2, of positron annihilation with electrons localized on carbon atoms and **in** the interionic spaces, **respectively,** as well as electron localization radii, $r_{m]}$, recalculated from the gaussian parameters o\, a_2 according to the formula given in [6]:

$$r_m = (3/2)^m(h/mca).$$

The analysis of the positron annihilation data enables one to conclude that the van der Waals lengths of 0,24 nm (the distances between the outer electron shell of carbon atoms in adjacent grapheen sheets) are the same, within experimental error, in graphite and multiwall carbon nanotubes. This inference can be used for experimental determination of the number of grapheen layers in nanotubes by means of the positron annihilation technique.

Table

Sample	Medium Gaussian (MG)		Broad Gaussian (BG)	
	r_{m1}, nm (±0,001)	5,, % (±0,5)	r_{m2}, nm (±0,001)	(±0,5)
Graphite	0,112	82,5	0,035	17,5
Fullerite C_{60}	0,121	78,3	0,041	21,7
Nanotubes:				
1-hour growth	0,110	91,9	0,053	8,1
5-hour growth	0,109	94,0	0,042	6,0

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