Nanocomposites and nanomaterials

EPR spin probe study of the dynamics of nanostructured carbon materials.

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Recent advances in the synthesis and research of carbon nanomaterials have led to the substantial growth of their implementation in the sphere of fabrication of nanoelectromechanical and optoelectronic devices. More profound understanding of the processes of their local and global dynamics is necessary for the interpretation of macroscopic properties and for the prediction of new phenomena.

In our current research, multiwall carbon nanotubes, thermally expanded graphite and several samples of nanoporous activated carbon with the surface values from 50 up to 1700 m^2/g and average pore radii of 5-80 A were studied using EPR spin probe method. Four classical stable radicals - amphiphilic TEMPO and TEMPOL alongside with hydrophobic 5-DSA and 16-DSA were weakly bounded to the surface of carbon nanomaterials. The EPR experiments were performed in a temperature range of 130 – 360 K, all of the spectra belong to a region of extremely slow motion of spin probes. Their rotational correlation times were calculated according to semi-empirical formula, which used parallel hyperfine splitting A_{zz} between the low and high field spectral components and the same parameter measured from the spectra of the radicals deposited on bulk graphite, at T=77 K. Reverse values of these parameters correlated with the global dynamics of the nanostructured material in the case of nitroxide spin probes and with the dynamics of graphitized fragments in the case of doxylstearic compounds. It was shown that surface values and nanopore size distribution could affect both global and local dynamics of the materials investigated.

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