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Investigation of activated carbon materials with nano-size pores using nitroxide radical.

V.A. Trykhlib, V.V. Strelko, T.I. Myronyuk, A.K.Melnyk, V.V. Trachevskyi and V.V. Brei

Institute for Sorption and Problems of Endoecology, Natl. Acad. of Sci. of Ukraine. Generala Naumova str., 13, Kiev-03164 , Ukraine.

Activated carbon materials and their derivatives are widely used in the fields of technogenic pollutants sorption, enterosorption, biomedical applications and livestock breeding as well. Sorption capacity and selectivity of the ACM are mainly determined by structural properties, it is possible to control them during the activation process and the following thermal treatment. Inclusion of heteroatoms into the structure of ACM could result in drastic changes in their physicochemical properties.

We have investigated initial and modified ACM produced from a synthetic carbonaceous source, with primary nanopore size about 1 nanometer. EPR spectroscopy was used to study the specific properties of the activated carbon samples structure transformations and EPR nitroxide spin probe TEMPOL (4-hydroxy-2,2,6,6-tetramethyl-1-piperidinyloxyl) has been applied for the analysis of sorption ability of activated carbon to widely used solvents. Spectra of ACM suspensions were a superposition including a triplet belonging to a “free” state of radicals localized into the solution or in carbon macro- and mesopores and a singlet, which corresponds to a strong exchange interaction of spin probes, localized into nano-sized pores. In the first approximation we can consider an absorption efficiency as a correlation of EPR triplet component in suspension to the triplet signal belongs to the initial solution. Measurements have shown that even high nitroxide concentrations are effectively aggregated by the ACM with the proportional growth of radical concentration on the carbon active surface.

Calculated values of rotational diffusion correlation times of radicals in the temperature range from 140 to 300 K were used to determine the phase transition of water absorbed into the ultramicropores of ACM.

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