

Influence of molecular oxygen on magnetism of disordered nanocrystalline carbon

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Magnetic properties of disordered nanocrystalline carbons have not yet been sufficiently studied. We report the results of our studies of magnetic properties of glass-like carbons (GLC600) obtained by pyrolysis of furfuryl alcohol at 600 °C. This material is chosen because, due to its very low electrical conductivity, the temperature dependence of the intensity (χ_{EPR}) of electron paramagnetic resonance (EPR) line is not affected by the contribution of Pauli paramagnetism. We have previously shown that in vacuum, exchange interactions between paramagnetic centers in other glass-like carbons give rise to exchange-coupled pairs [1]. Our EPR investigations of GLC600 in vacuum show a non-Curie $\chi_{EPR}(T)$ dependence. However, exposure to molecular oxygen leads to significant changes in EPR properties. In addition to the expected broadening of the EPR line [2], O₂ molecules adsorbed on the surface and inside the pores cause a Curie-type dependence in the temperature range of 10-100 K and an unexpected increase in χ_{EPR} above 170 K. To check the O₂ contribution to the magnetic susceptibility of GLC600, the vibrating sample magnetometry is used. The temperature dependence of magnetic susceptibility obtained for our material by this technique is similar to that observed for activated carbons fibers (ACF) [3], despite the fact that the surface area of GLC600 [4] is two orders of magnitude smaller than that of ACF. This dependence confirms the presence of O₂ molecules adsorbed on the surface and in pores (with the mean diameter of 0.9 nm) of GLC600. These results allow us to conclude that in GLC600 dipole-dipole interactions between paramagnetic centers (PCs) and magnetic moment of O₂ modify the exchange interactions between PCs.

References:

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