Nanocomposites and nanomaterials

Anomalous paramagnetic behavior of the pyrolyzed nanostructured carbon (natural coal)

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Coal is a natural nanostructured carbon material, structural and physicochemical properties of which depend on the degree of metamorphism. Structural transformations of coal with different V^{daf} under pressure and temperature are typical processes of carbonization, which are also accompanied by changes in physical and chemical properties, including paramagnetic.

In this work the influence of molecular oxygen O_2 on the paramagnetic properties of gaseous types coals LG and G (V^{daf} = 39-46 wt.%) after vacuum annealing at T= 650 °C÷720 °C is studied by the EPR method.

EPR spectra of samples after annealing consist of two Lorentzian shape lines: L1 and first registered line L2. The nature and characteristics of the line L1 coincide with those for unannealed samples, in particular, L1 broadens with increasing of oxygen concentration [1]. Instead, the line L2 unexpectedly shows the opposite behavior. The L2 line is registered as anomalously broad EPR line (ΔH_{pp}~250 G) after the contact of the annealed sample with air. L2 gradually narrows with further contact of the sample with air. The study of the correlation behavior between L1 and L2 lines demonstrated the difference not only in broadening mechanism but in the nature of centers. The results are discussed within the developed model which takes into account both the possibility of the time-dependent variation of opened and closed pores ratio and the structure modification of the paramagnetic centers by creating bonds with oxygen. Finally, we investigated the influence of water and water vapor on the behavior line L2. The results qualitatively confirm the model proposed.

1. *A. A. Konchits, B. D Shanina, M.Ya. Valakh et al*. Local structure, paramagnetic properties, and porosity of natural coal: Spectroscopic studies // Journal of Applied Physics – 2012. -**112**, N 4.-P. 100 – 109.