Nanocomposites and nanomaterials

Local structure and paramagnetic properties of the nanostructured carbonaceous material shungite

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Using a scanning electron microscopy (SEM), chemical analysis, electron paramagnetic resonance (EPR) and Raman scattering (RS) methods, two types of the shungite materials (Sh-II from Zazhogino deposit and shungite from a commercial filter (ShF)), with different carbon content and porosity are studied in this work. The study is carried out with the aim to understand, what properties of shungite are peculiar, what is a role of the interface between carbon and quarts fractions, and what defects are the most important for application of shungite.

It is established by SEM data that structure of the shungite samples are formed by a micron size agglomerations of carbon and silicon dioxide clusters. It is found from Raman data that carbon fraction is formed from sp^2-hybridized clusters, size of which increases from 9 nm up to 12 nm after annealing of the samples.

High conductivity of shungite is found to belong to the carbon nanoclusters of different sizes. Big clusters give the conduction electron spin resonance (CESR) signal with a Dysonian line shape, while small clusters give a symmetrical EPR line with variable g-factor and line width.

The careful search a nature of two other narrow EPR signals in shungite, which used to be prescribed to fullerene like molecules [1], is fullfield. Here is shown that the oxygen-deficient E'_γ centres are responsible for these signals. A strong correlation is revealed between concentration of E'_γ centres and the line width of CESR, which occurs under annealing process of the samples with a presence of extended interfaces between fractions, at T=580 K. The correlation reason is a spin-spin interaction between two spin systems and formation of new E′centres with rate $\tau^{-1}= 5.3\cdot10^{-4}$ s^{-1} at T=580 K.

1. *Kovalevski V.V., Rozhkova N.N., Zaidenberg A.Z.,Yermolin A.N.* Fullerene-Like Structures in Shungite and their physical properties // Mol. Mat. 1994. V.4. P. 77-80.