An effect of annealing on shielding properties of shungite

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1. Introduction

Rapidly developing field of nanotechnology is using in the production of building materials. Shungite is a natural mineral **containing composition of fullerenes**. **This mineral is of interest due to ability to adsorb electromagnetic and ionizing radiation**. Along with this feature shungite is a powerful **bactericide**. Materials containing shungite reveal biodamage resistance. Shungite prevents also electrostatic charging, as it is electroconductive [1].
A wide range of useful shungite properties depends on the structure shungite rock. According to [2], the elementary fragment of shungite carbon structure is a globule of about 100 Å. The globules can be surrounded by a random network of carbon and impurity atoms. They can be oriented both randomly and collected in packs, fiber, bags, layers, and can be arranged providing an anisotropy of physical properties. It is commonly assumed that carbon in the shungite structure is presented in the chained form and characterized by a persistent constraints of -C≡C- and =C=C= groups [3].
In shungite minerals there are also water, oil and water sensitive bitumens organics, fullerenes, C60 and C70, and nanotubes in the carbon globules (Fig. 1).

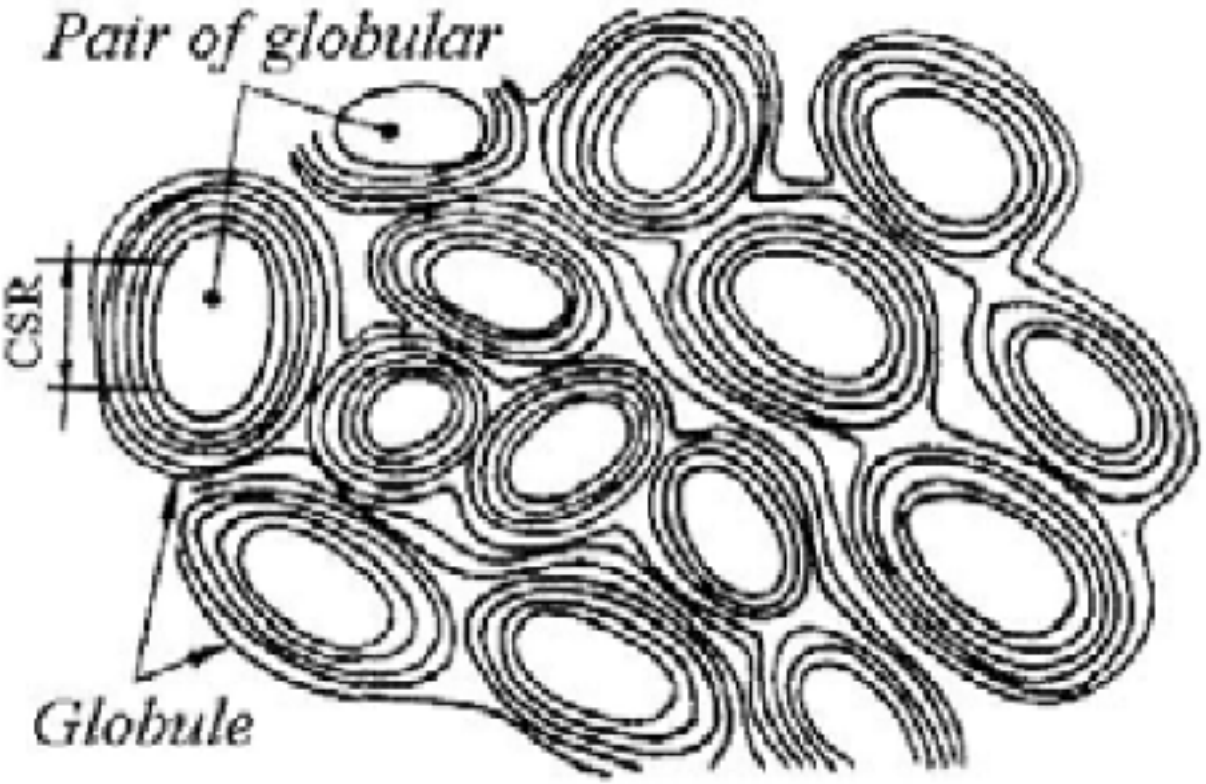

Figure 1. Model of a globular structure of shungite carbon [4].

The first important property of shungite is electromagnetic shielding fields. That is very important nowadays, when levels of electromagnetic fields can valuably exceed the standards. Sources of electromagnetic fields are cellular repeaters, radar stations, transformer substations, radio air and naval facilities, highvoltage power lines, etc. **A number of electromagnetic radiation shielding materials to protect a human body against mobile phone radiation on the basis of shungite were also proposed.** This paper shows an effect of the environment in the annealing gas chamber on shielding properties of shungite powdered with grain size less than 20 μm.

2. Experimental

The samples were subjected to thermal annealing for 2 h at 900 °C in different environments: the oxidizing atmosphere, products of NH4Cl decomposition, and vacuum.

The frequency dependences of transmission and reflection in the frequency range of 8-12 GHz were obtained for a series of heat-treated samples.

3. Results and discussion

Transmission coefficients determined for all annealed samples (Fig. 2) enter the range of -4.9… -8 dB. For unannealed shungite the transmission is much lower, -17.5… -19.5 dB.

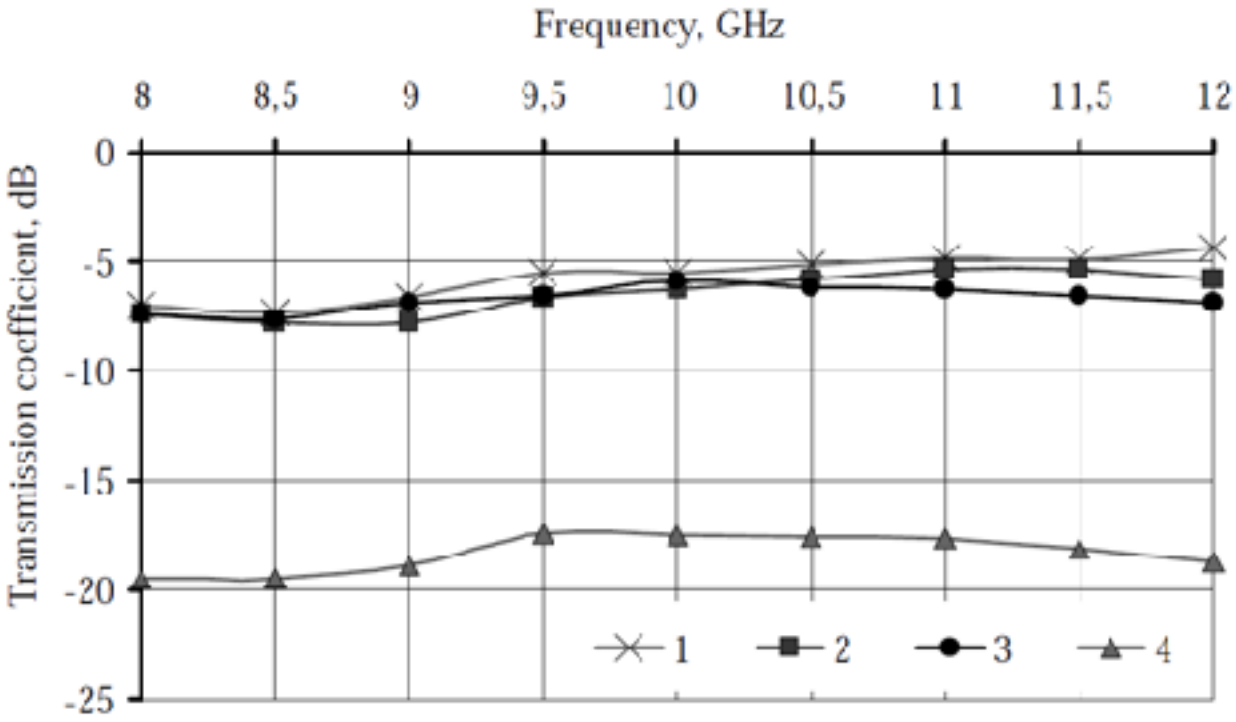

Figure 2. Frequency dependence of the transmission coefficient for shungite annealed in the oxidizing conditions (1); in a chamber with NH4Cl (2); in vacuum (3); and for unannealing shungite (4).

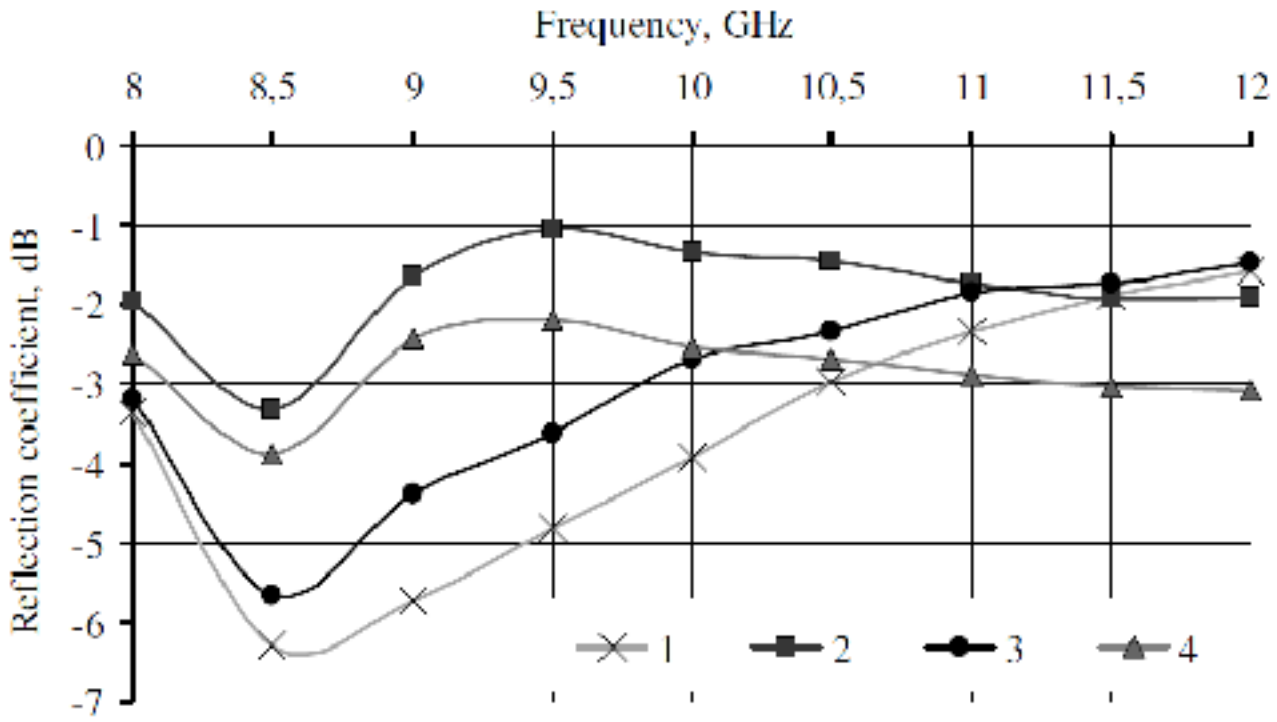

Figure 3. Frequency dependence of the reflection coefficient with metal reflector for shungite annealed in the oxidizing conditions (1); in a chamber with NH4Cl (2); in vacuum (3); and for unannealing shungite (4).

The reflection coefficient (Fig. 3) is observed to be less for the samples after annealing in the oxidizing conditions and in vacuum than for virgin shungite (-2.2 … -4 dB). The lowest reflection in the frequency range of 8.5-10 GHz was obtained for shungite annealed in the oxidizing condition (-4 ... -6.2 dB), while the reflection coefficient for shungite annealed in vacuum is -2.5 … -5.5 dB in the same frequency range.

4. Conclusion

Thermal annealing of powdered shungite in oxidizing conditions was shown to result in an increase of the suppression effect of electromagnetic radiation. The reflection coefficient of the powdered shungite was measured to be reduced in the frequency range of 8-12 GHz down to -4 ... -6.2 dB after annealing at 900 °C for 2 h, and the transmission coefficient increased from -19 ... -8 dB up to -4.9 dB.

References

1. Nanosciences, nanotechnologies, nanomaterials construction, http://interlibrary.narod.ru/GenCat/GenCat.Scient.Dep/GenCatArchitecture/271200003/271200003.htm (14.01.2013).

2. A. B. Solovyeva, N. N. Glagolev, N. A. Zaichenko, in: “Carbonaceous formation in geological history”, Abstr. Int. Symp. (2-7 June 1998, Petrozavodsk: Karelian Res. Cent. RAS, Institute of Geology, 2000), p. 131.

3. V. I. Beryozkin, J. V. Kholodkevich, V. J. Davydov, ibid. p. 111.

4. I. A. Volkov, I. A. Kushmar, ibid. p. 121.