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LUMINESCENCE OF COALS EXCITED BY A PULSED ELECTRON BEAM *

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The purpose of this work is to study the spectral and amplitude-temporal characteristics of the luminescence of coals from the Kuznetsk Basin when excited by a nanosecond electron beam. The experiments were carried out at a temperature of T = 300 K. As objects of study, samples of coals of the following grades DG (long-flame gas) and K (coconut) were used [1]. Before carrying out, tablets of the corresponding grade of coal with a size of Ø17x4 mm were made. The density of the samples was 1.35 g/cm^3.

To measure the spectral and amplitude-temporal characteristics of the luminescence of the samples, an experimental complex was used, which was described in detail in [2]. A GIN-600 electron accelerator with an effective electron energy of 240 keV, a pulse duration of $\tau \approx 25$ ns, and an energy density of 20 J/cm^2 output to the sample was used as a source of sample luminescence excitation. The spectral range recorded during irradiation with a single pulse is 350-650 nm. The amplitude-time characteristics of the glow for all the studied grades of coals have the same character.

At this stage, we can give the following interpretation of the observed amplitude-time dependences of the glow. It is known that during the excitation of nonmetallic compounds by an electron beam, electron–hole pairs are generated at the first stage (in the case of coals, these can be free electrons and positively charged radicals). Some electrons are born near the genetic partner and quickly recombine with it through an excited state with the emission of luminescence quanta already during the irradiation pulse. Some of the electrons go a considerable distance from the genetic partner. In this case, diffusion of charged particles must be present to meet and recombine, which can lead to an observed increase in the luminescence intensity over a time of ~50 – 100 nm. The decrease in luminescence in the simplest case is associated with intracenter luminescence decay.

To study the mechanism of migration and dissipation of the energy introduced by the electron beam, more detailed studies are needed, for example, the measurement of the temperature dependence of the spectral-kinetic characteristics of the luminescence of samples. Measurements of this kind are of great interest and can provide information on chemical reactions in coals that occur under the action of a pulsed electron beam, and require a separate work.

In the luminescence spectra, a significant number of narrow bands can be distinguished, which are superimposed on a wide luminescence band. We have identified the bands. In all the studied coals, luminescence was found under the action of an electron beam, associated with a number of PAHs, most of which are carcinogens.

The experiments carried out showed that the luminescence arising upon excitation by a nanosecond electron beam has a luminescent nature with an increase in intensity in the time interval of 50–100 ns and a decrease over a time of 500 ns. In the luminescence spectra, the wide band is superimposed by a number of narrow bands associated with the luminescence of polycyclic aromatic hydrocarbons in the composition of the studied coals. The proposed method for detecting PAHs can be used as an express method for determining the presence of PAHs in coals and other organic objects.

REFERENCES

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