THERMAL LUMINESCENCE OF PETROLEUM LUMINOPHORES ACCUMULATING OF ENERGY OF γ- RAYS, THE LIGHT OF SPARK AND MERCURY-LAMP

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Many organic and inorganic compounds adsorbing in UV, visible and infrared range of spectrum efficiently accumulate and create the solar energy. Recently the various variants of adsorbed energy are investigated: heat engineering, photo- biological, photo-physical and chemical (including thermo- and photo-chemical processes).

The conversion of solar light energy to the proper light energy to the defined part of visible spectrum range is of great interest for the most of the scientific-technical issues. The oil luminophores (OL) that have a series of specific features particularly possess these properties. Oil luminophores accumulate and convert solar light in UV- range of spectrum to the visible light severely defined wavelength. Fractions of catalytic cracking and pyrolysis with the boiling temperatures of 200-300, 300-350, 350-400 and higher 400°C have blue-purple, bluish-blue, green and yellow luminescences under the influence of UV-light, Al-spark and mercury lamp (PRK). In all these cases under the influence of UV-light occurs the photo-physical processes conversion of energy with molecules of aromatic hydrocarbons (AHC) of luminophore according to the following scheme:

$$AHC\ (S) + hv_1 \text{--- } AHC^*\ (S^*) \text{---} AHC\ (S) + hv \qquad (1)$$

It should be noted that under the influence of UV-light, Al-spark and mercury lamp in OL occur not only energy conversion, but also it accumulation. The latter carried out by two-quantum ionization of AHC:

$$AHC\ (S) + hv_1 \text{--- } AHC^*\ (S^*) \text{---} AHC^*(T)$$

$$AHC^*(T) + hv_2 \text{--- } AHC^{**} + e^- \qquad (2)$$

On the other hand, accumulation proceeds by the way of sensibilized decomposition of the excited molecules of naphtheno-paraffinic hydrocarbons (HR) that are the parts of OL:

$$AHC^*(T) + hv_3 + RH \text{ --- } AHC^*(T^*) + RH \text{ --- } AHC(S) + RH^* \text{ --- } AHC(S) + R^* + H^* \qquad (3)$$

where S. S*, T, T*–are respectively basic and excited singlet and triplet state of AHC molecules, e^- – electron.

During irradiation of OL rays which have the high-energy along with reactions (2) and (3) occur the direct excitation and ionization of molecules of naphtheno-paraffinic hydrocarbons that are not inconvertible and in the result of ionic-radical reactions are converted to the carbocation and radical $R^\bullet$:

$$RH^{+\bullet} + RH \rightarrow RH_2^+ + R^\bullet \qquad (4)$$

Thus, in the result of irradiation of OL with the quanta of various energies, as a whole, is generated five kinds of paramagnetic particles: electron (e^-), alkyl radical ($R^\bullet$), atomic

hydrogen, cation-radical ($AHC^{+\bullet}$), anion-radical ($AHC^{-\bullet}$). These particles are stable at the temperature of liquid nitrogen (-196°C), therefore irradiation of OL was conducted at this temperature.

Accumulated energy releases during the heating of irradiated OL in the form of light energy in recombination of e^- (at -196°C), $H^\bullet$ (-165°C), O_2 (-108°C) $R^\bullet$ (-75°C), $AHC^{+\bullet}$ (at the temperature of solidification of OL – 26°C) according to the following scheme:

$$e^- + AHC^{+*} \text{---} AHC^* \text{--} AHC + h\nu$$

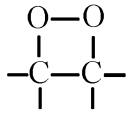
$$H^* + H^- + AHC^{+*} \text{--} H_2 + AHC + h\nu$$

$$O_2 + R^- + AHC^{+*} \text{---} RO_2 + AHC + h\nu \qquad (5)$$

$$R^* + R^- + AHC^{+*} \text{---} R_2 + AHC + h\nu$$

$$AHC^{+*} + AH^{-*} \text{---} 2\,AHC^* \text{---} 2h\nu$$

As it seen from (5) in all variants of reactions recombination of the particles the same quantum of light irradiates. This is because the released electron recombines with the cation radical of $AHC^{+\bullet}$ and causes the luminescence of AHC. Really, the investigation of luminescence spectral composition in the range of all detected maximums of photothermoluminescences (PTL) showed that they are identical.

For many organic and inorganic compounds, the most high-temperature release of accumulated energy carries out at the temperature of their melting and devitrification (crystalline and amorphous compounds). However, this process for OL occurs at the temperature exceeding its temperature of solidification. Established that higher of these temperatures is observed another three maximums PTL (at 52, 120, 140°C). However, these maximums unlike low-temperature ones carry out not recombined, but monomolecular dissociative nature and conditioned according to the decomposition of tetraoxide (ROOOOR), dioxetanes  and endoperoxides of AHC.

Analysis of experimental data showed that the ratio of accumulated energy before and after the temperature of solidification of OL significantly depends on the energy of the quanta radiation of energy source. This ratio for the radiation of Co>>Al-sparks>mercury lamp>glow lamps relates to the efficiency of ionizing capability of these energy sources in average.

The efficiency of low-temperature as well as high-temperature PTL depends on the quantum yield of luminescence AHC which increases the ratio of thermally luminescence energy to the absorbed by its increasing.

The big coefficient of the aromatic hydrocarbons absorption and their significant quantity in OL (to weight of 90 %) promotes increasing of efficiencies of solar energy absorption by them. Therefore, it should be offered that they could be the components promoting the increase of efficiency of synthetic luminophores of the long-time afterglows.