

THE SPECTRUM OF THERMALLY STIMULATED CURRENT OF γ - IRRADIATED IN POLYETHYLENE NANOCOMPOSITES

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In this work by means of the method of thermo activation spectroscopy it has been studied accumulation and charge relaxations in samples of composite system on the basis of the high density polyethylene (HDPE) with a nanodisperse filler dioxide of silicon (SiO_2) it has been studied in this work by means of the method of thermo activation spectroscopy.

For creation of composites it has been used the powder technology which consists in mixing of powders of filler and of the dielectric matrix with the subsequent short-term pressing of homogeneous mix at the temperature exceeding transition temperature of polymer in a plastic state. This composite allows achieving close to random casual distribution of particles of disperse phase. The size of particles of additives was $20\mu\text{m}$. The samples for studies were prepared in the form of disks thickness 70-100mkm and diameter 40mm, they were subjected to γ - irradiation on installation ^{60}Co at room temperature. Electrization of samples from the side of a nonmetallized surface was carried out by negative corona at a voltage of 6kV, charging time was 300s. Just after the polarization, the thermally stimulated current (TSC) was measured. The volume content of filler in the studied composites was up to 5%, and the absorbed dose $5 \cdot 10^4 \text{Gy}$. Among the studied samples of composites HDPE +1%vol. SiO_2 finds the greatest influence of γ - radiation at a dose of $5 \cdot 10^4 \text{Gy}$. Therefore in figure it is depicted the spectra TSC for HDPE +1%vol. SiO_2 polarized in corona discharge (curve 1, coronaelectret), preliminarily irradiated by γ - quanta in the air and then polarized corona discharge (curve 2), and also γ -irradiated (curve 3, radio electret). From the figure, it is seen that after the corona discharge in the TSC spectrum it is possible to see two peaks in HDPE +1%vol. SiO_2 - at 320K and 388 K, respectively (curve 1), and the maximal current value for the low-temperature and high-temperature peaks is almost identical, but differs with peak width. The existence of the peak at 320K points to the fact that, in the studied film it is mainly filled up with low-energy traps, which are localized in the surface layers of the film. The charges carriers become free from these traps under at lower temperatures. The second peak (curve 2) in the spectra of TSC of this sample at a temperature of 388K apparently, is related mainly with the release of charge carriers from deeper power traps at limit of the section of phases. On the spectra of the TSC there is only one peak in HDPE +1%vol. SiO_2 at the range of 330K (curve 2).

We assume that the γ - irradiation increases electric conductivity of the composite, owing to that the charge carriers from the zone of corona discharge can't get into the sample volume rather deeply and are captured under the surface traps. In this case there is no high-temperature peak, and low-temperature will shift rather low-temperature peak of corona electret of HDPE+1%vol. SiO_2 approximately on 100 towards high temperatures.

After the influence of γ -irradiation on preliminary corona discharge (curve 2) the films of HDPE +1%vol. SiO_2 on the spectra of TSC it is found one peak at a temperature of 330K. From the figure (curve 3) it is seen that composite HDPE +1%vol. SiO_2 subjected only to gamma radiation finds a small peak at the temperature of 383K, absent low-temperature peak on spectra TSC.

The characteristics of the electrets of composite HDPE +1%vol. SiO_2 are presented in the table.

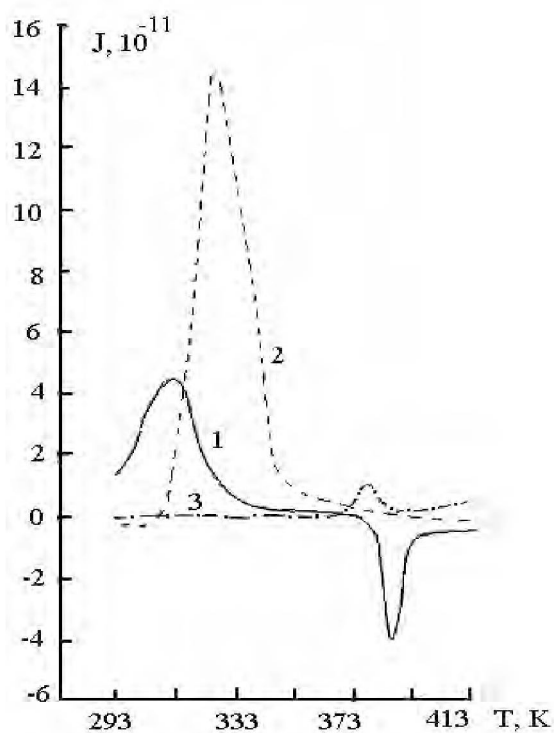


Figure. The curves of the TSC for the HDPE +1%vol.SiO₂, polarized in corona discharge(1), preliminarily irradiated and then polarized in corona discharge (2) and γ -irradiated (3).

Perfomances Material	Temperature of the max., T _m , K	Energy activ. of U, eV	Charge Q, C
HDPE +1%vol.SiO ₂ (coronaelectret)	320 (I peak) 388 (II peak)	0,0085 0,59	3,63·10 ⁻⁸ 6,7·10 ⁻⁹
HDPE +1%vol.SiO ₂ (charging in the corona discharge after the preliminary radiation)	330	0,034	1,05·10 ⁻⁷
HDPE +1%vol.SiO ₂ (radioelectret)	383	0,3	0,61·10 ⁻⁹