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Fourier-IR spectroscopic study PE/CdS+ZnS composite films

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FOURIER-IR SPECTROSCOPIC STUDY PE/CdS+ZnS COMPOSITE FILMS

E.G. Hajieva

Institute of Radiation Problems of ANAS
egana.hajieva@yandex.ru

Abstract: The change in spectral properties of PE/CdS+ZnS composites at room temperature (T=300K) under the influence of gamma quanta was studied by Fourier-IR spectroscopy. It is shown that the spectral properties of PE/CdS+ZnS composites vary depending on the amount of filler and the radiation dose. It was revealed that with an increase in the absorbed dose, the intensity of the absorption bands with maxima 724 and 723 cm^{-1} are redistributed and this leads to a change in the supramolecular structure.

Keywords: Fourier-IR spectroscopy, composite, ɤ-irradiation, filler, PE/Cds+ZnS.

1. Introduction

Currently, the development of electronics and electrical engineering requires the creation of single or composite materials with thin layers that have electrical active properties. The effects of structural changes that have been studied, which are formed as a result of changes in the technological parameters and composition by electrical properties when obtaining these active composites are one urgent problem of nanoelectronics. IR spectroscopy and other optical methods are widely used to study the features of the formation of the structure and properties of polymer composites with different fillers. The IR spectrum of composites allows you to obtain valuable information about their structure, various crystalline forms, and interfacial interaction between components. The characteristic frequencies of oscillations belonging to inter-component connections in spectra largely depend on the chemical composition of the sample and the properties of the polymer matrix [1-3].

The study of polyethylene with composites based on them by Fourier IR spectroscopy can lead to many interesting results in this approach. For this purpose, in this work, composite PE/CdS+ZnS films were studied by Fourier-IR spectroscopy in different percentages before and after gamma irradiation.

2. Method of the experiment

The preparation of composite materials in this work is as follows: the powdered components of the polymer and filler (CdS+ZnS sulfides) in different percentage ratios are mixed mechanically, after which, under pressure from 10-15 kPa, they are pressed with a hot press. The press forms attached to the punches were heated to the desired temperature using heaters mounted in them. A temperature change, and temporary, baric regimes made it possible to obtain polymer films and samples of compositions with different morphology and structural features. To obtain filled samples, a hot pressing method was used.

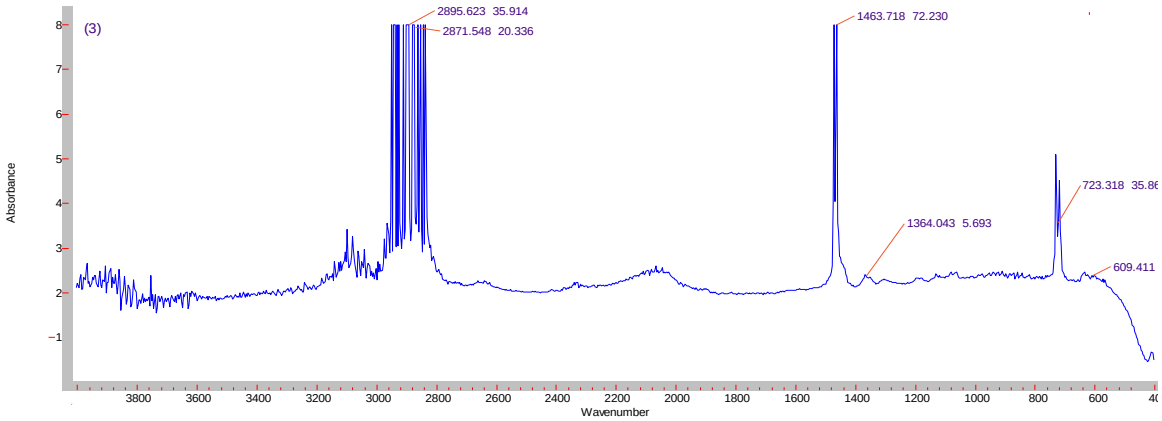
As a matrix for the manufacture of composite materials, polyethylene (PE) was selected, as one of the cheapest and most frequently used polymers, the addition of a filler to which does

not cause any difficulties. Thus, the purpose of the work was to create new, more effective polymer-sulfide CdS+ZnS composites, with electronic properties for electronic and transformative technology and modification of these properties by ionizing radiation [4, 5].

Fourier-IR-spectra of absorption are registered on the Varian 640FT-IR spectrometer in the range of 4000-400 cm^{-1} at room temperature. The thickness of the samples was ~ 1μm. The samples were irradiated at the isotopic source ^{60}Co dose are dD_γ/dt = 182,244 rad/s. The dosimetry of the source is carried out by ferrosulfate and methane dosimeters. The absorbed radiation dose in the systems under study was determined by comparing the electron densities [6]. The radiation dose was D_γ = 30 -100 kGy.

3. Results and discussion

Figure 1 shows the Fourier-IR spectra of the initial and gamma-irradiated PE/CdS+ZnS composite films, the percentage ratio is 70:30. The choice of mass content of microparticles (70:30) PE and CdS+ZnS is because in this context the degree of crystallinity has a maximum value. As can be seen from fig. 1, with an increase in the absorbed dose, the intensities of the absorption bands with maxima at 724 and 723 cm^{-1} are redistributed. It can be seen from this that in polymer composite films, the intensity of the IR band of the crystalline 724 and amorphous 723 cm^{-1} phase changes compared to the intensity of the band of the initial unirradiated films.



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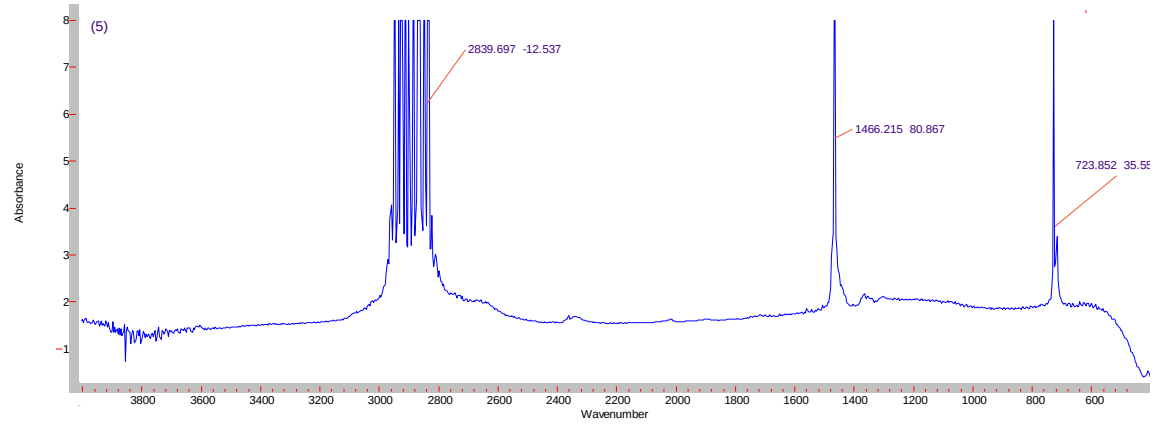

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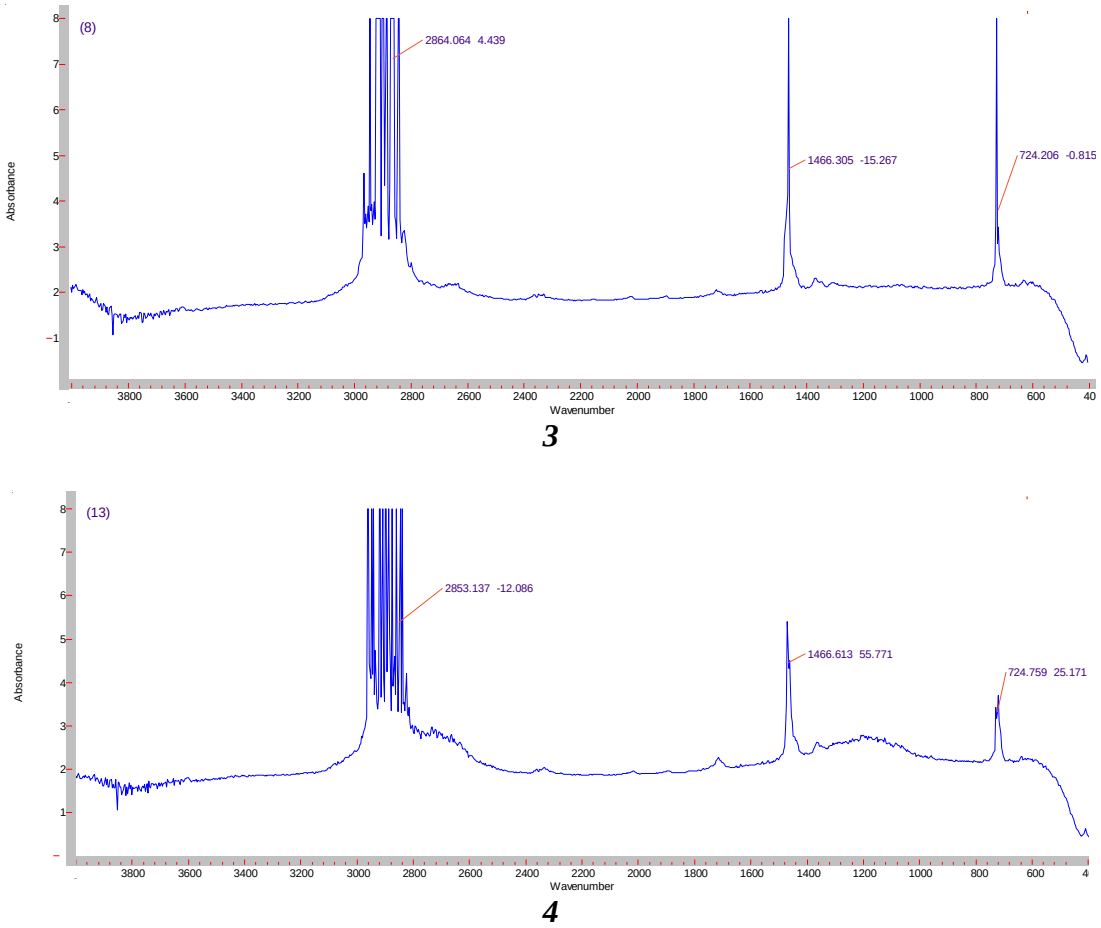

Fig. 1. Fourier-IR absorption spectra of PE/ CdS+ZnS:1 – initial; 2 - D_γ=30 kGy; 3- 50 kGy; 4-100 kGy (T=300K)

For samples of PE/CdS+ZnS, with an increase in the absorbed dose to Dγ=100 kGy, it decreases. This indicates that PE/CdS+ZnS polymer composites are more resistant to radiation. The observed features are associated with the formation of radiation defects in the PE matrix and a change in the interaction at the interface.

Due to the change in interfacial interaction, the supramolecular structure of the polymer (SMS) changes. Active centers created in the matrix after γ-radiation interact with the surface of CdS and ZnS, which leads to a change in the degree of crystallinity and, accordingly, the structure of the composite [7].

4. Conclusion

The possibility of using Fourier-IR spectroscopy for structural changes in polymer composite materials with phosphor fillers under the action of γ-radiation is shown. It was found that PE/CdS+ZnS polymer composites have high radiation resistance in the absorbed dose range D_γ=30-100 kGy. It was found that with an increase in the absorbed dose, the intensities of the absorption bands with maxima at 724 and 723 cm^{-1} are redistributed. The observed change in the degree of crystallinity is associated with a change in the supramolecular structure of the γ-irradiated composites.

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ФУРЬЕ-ИК-СПЕКТРОСКОПИЧЕСКОЕ ИССЛЕДОВАНИЕ КОМПОЗИТНЫХ ПЛЕНОК ПЭ/CdS+ZnS

Е.Г. Гаджиева

Резюме: Методом Фурье-ИК-спектроскопии изучено изменение спектральных свойств композитов ПЭ/CdS+ZnS при комнатной температуре (T=300K) под воздействием γ-квантов. Показано, что спектральные свойства композитов ПЭ/CdS+ZnS изменяются в зависимости от количества наполнителя и дозы облучения. Выявлено, что с увеличением поглощенной дозы, интенсивности полос поглощения с максимумы 724 и 723 $см^{-1}$ перераспределяются и это приводит изменению надмолекулярной структуры.

Ключевые слова: Фурье-ИК спектроскопия, композит, γ-излучение, наполнитель, ПЭ/CdS+ZnS

PE/CdS+ZnS KOMPOZİT TƏBƏQƏLƏRİN FURYE-İQ SPEKTROSKOPİK TƏDQİQİ

Y.G. Hacıyeva

Xülasə: Furye-İQ-spektroskopiya metodu ilə otaq temperaturunda γ-kvantların təsiri altında PE/CdS+ZnS kompozitlərinin spektral xassələrinin dəyişilməsi öyrənilmişdir. Müəyyən olunmuşdur ki, doldurucunun miqdarından və şüalanma dozasından asılı olaraq PE/CdS+ZnS kompozitlərinin spektral xassələri dəyişir. Udulma dozasının artması ilə 724 və 723 sm^{-1} maksimumlu udulma zolaqlarının intensivliyi paylanır və bu da üstmolekulyar quruluşun dəyişməsinə səbəb olur.

Açar sözlər: Furye-İQ spektroskopiya, kompozit, γ-şüalanma, doldurucu, PE/CdS+ZnS