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Quantum Dots CdTe Are the Fluorescence Nanocatalysts of Coumarin in the Interaction with the Ultra-low Concentration Ammonia Molecules in the Film Nanocomposites

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Ammonia belongs to a group of biomarker compounds that can be actively appeared in a body under certain diseases; it can be extracted by it to the environment in a relatively very low concentrations. The identification of emerging ammonia molecules and the intensity of its extraction by human or animal body timely have great diagnostic value; it is a difficult analytical task at the same time.

The aim of this work was the creation of a composite film structures both with immobilized dyes, which exhibit the molecules of ammonia interaction and which are used for its determination by fluorescence analysis, and with the quantum dots which are nanoparticles of a semiconductor material with dimensions 1-10 nm, known for its properties to enhance the luminescence. Quantum dots (QD) of diameter up to 10 nm, with a luminescence band maximum at the wavelength of 549-550 nm, covered with a thioglycolic acid molecular shell (production of the Buknanotekh enterprise, Chernivtsi, Ukraine) were used. Coumarin-7 which is a natural phenolic heterocyclic compound, based on 9,10-benzo-b-pyrone, with the ability to absorb monochromatic light at a certain wavelength depending on the concentration of the corresponding solution was used as the organic dye molecules. It is assumed that ammonia forms a complex cation of ammonia - anion of coumarin in the interaction with coumarin. Films production technology of entire structure with thickness, approximated to several microns, was developed. The studies of their characteristics showed that films with complex QD/Coumarin-7 in polymeric matrix provide a clear response to ammonia vapors by significant falling of fluorescence intensity (10-13% of the original). The ability of the film sample reuse is retained after interaction with the ammonia molecule. It is shown that QD immobilization into a film complex with coumarin increased the intensity of the complex luminescent signal (up to 76% in comparison with the dye own intensity), which suggested that the quantum dots CdTe are the fluorescence nanocatalysts of coumarin in the interaction with the ultra-low concentration ammonia molecules.