МІНІСТЕРСТВО ОХОРОНИ ЗДОРОВ'Я УКРАЇНИ
БУКОВИНСЬКИЙ ДЕРЖАВНИЙ МЕДИЧНИЙ УНІВЕРСИТЕТ»

М А Т Е Р І А Л И

105-ї підсумкової науково-практичної конференції
з міжнародною участю
професорсько-викладацького персоналу
БУКОВИНСЬКОГО ДЕРЖАВНОГО МЕДИЧНОГО УНІВЕРСИТЕТУ
присвяченої 80-річчю БДМУ
05, 07, 12 лютого 2024 року

Конференція внесена до Реєстру заходів безперервного професійного розвитку, які проводитимуться у 2024 році № 3700679

Чернівці – 2024

УДК 001:378.12(477.85)
ББК 72:74.58
М 34

Матеріали підсумкової 105-ї науково-практичної конференції з міжнародною участю професорсько-викладацького персоналу Буковинського державного медичного університету, присвяченої 80-річчю БДМУ (м. Чернівці, 05, 07, 12 лютого 2024 р.) – Чернівці: Медуніверситет, 2024. – 477 с. іл.

ББК 72:74.58

У збірнику представлені матеріали 105-ї підсумкової науково-практичної конференції з міжнародною участю професорсько-викладацького персоналу Буковинського державного медичного університету, присвяченої 80-річчю БДМУ (м. Чернівці, 05, 07, 12 лютого 2024 р.) із стилістикою та орфографією у авторській редакції. Публікації присвячені актуальним проблемам фундаментальної, теоретичної та клінічної медицини.

ISBN 978-617-519-077-7

makes it possible to increase the effectiveness of therapy and become an important biomarker for monitoring disease progression.

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DEVELOPMENT OF PHOTOSENSITIVE MATERIALS BASED ON TITANIUM DIOXIDE AND MEROCYANINE DYES

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Introduction. Since the emergence of life on the Earth, the environment has been polluted by natural and synthetic wastes. In case of natural pollution, the environment independently controls the impact of pollution. However, synthetic materials accumulate in the environment, and therefore, their ingress into the environment, even in small concentrations, can lead to catastrophic consequences. Recently, one of the most urgent tasks facing scientists is to create environmentally friendly chemical technology, materials and processes to combat global pollution and environmental destruction. Much attention is paid to studying light-induced photocatalytic reactions. The use of wide band gap semiconductors like TiO_2 as catalysts, and the consideration of its reaction to UV radiation, not only intensify photocatalysis research but also contribute to the study of the superhydrophilicity of TiO_2 in its use for environmental remediation and solar energy production. For visible photocatalysis, doped-TiO_2 with a sensitizing dye or a narrow band gap semiconductor can be used.

The aim of the study. Our work aims to investigate the possibility of creating new broadband catalysts based on titanium (IV) oxide and merocyanine dyes with different lengths of the polymethine chain and different groups at its ends.

Material and Methods. To obtain photosensitive heterostructures, we used titanium dioxide P25 (Degussa), merocyanine dyes D1-D3, and the polymer (polyepoxypropylcarbazole). The absorption spectra of the dye solutions were recorded on the Ocean Optics USB 2000+XR spectrophotometer. The redox potentials of the dyes were determined by cyclic voltammetry using a BAS 100B/W Electrochemical Workstation (Bioanalytical Systems) with a standard three-electrode cell in 0.1 M tetra-n-butylammonium tetra-fluoroborate solution.

Results. Oxidation and reduction potentials were determined for merocyanine dyes used as TiO_2 sensitizers by cyclic voltammetry, which were applied for HOMO and LUMO energy calculations and construction of energy diagrams of their energy levels relative to titanium dioxide levels. The obtained spectral and electrochemical data were used to determine the dye electron transition energy from the ground state to the excited state. The difference between the light absorption energy and the oxidation and reduction potentials was found to be slight, which allows using the proposed methods to find the energy values. The obtained spectral and electrochemical data were used to determine the dye electron transition energy from the ground state to the excited state. The difference between the light absorption energy and the oxidation and reduction potentials appeared to be small, which makes it possible to use the proposed methods to find the energy values. To ensure the normal functioning of a photocatalytic system, all its relevant energy parameters must be balanced so that all light-induced electron transfer processes are thermodynamically resolved and have an appropriate driving force. In case of a heterostructure based on dye-sensitized TiO_2, this condition must be satisfied for both processes: light absorption by the dye and light excitation of the semiconductor component of the heterostructure. Therefore, the lowest unoccupied energy level of the sensitizer should be located above the upper edge of the conduction band of the semiconductor to ensure electron transfer from the excited dye-sensitizer to the conduction band of the semiconductor. The oxidation potentials of electronically excited dyes (LUMO level) of the studied heterostructures are located above the edge of the TiO_2 conduction band. Thus, the injection of electrons into this band is thermodynamically allowed, which means these dyes can sensitize TiO_2.

Conclusion. New photosensitive heterostructures based on titanium dioxide and merocyanine dyes have been created. The spectral, electrochemical, and energy characteristics of

the studied dyes were determined. The results obtained indicate the possibility of sensitizing TiO_2 with the investigated merocyanine dyes and creating photosensitive photocatalytic systems based on them.

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INVESTIGATION OF THE OPTICAL PROPERTIES OF CdS COLLOIDAL SOLUTIONS DOPED WITH Ag+ IONS

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Introduction. The creation of core-shell heteronanostructures expands the possibilities of using semiconductor nanocrystals as new efficient catalysts, as well as for the production of flat displays, diodes, and sensors. In order to modify the optical properties of CdS NPs, in many works, the possibility of doping them with cations of d-elements Ag+,Cu^{2+}, Pt^{2+} was investigated.

The aim of the study. To investigate the influence of Ag+ ion concentration on optical properties, photoluminescence quantum yield, monodispersity, agglomeration number and stability over time.

Material and methods. The synthesis of heterostructures based on nanosized CdS with the addition of silver salts was carried out according to the coprecipitation scheme:

$$(xMe + yCd^{2+})/L\text{-}Cys + (x+y)S^{2-} \rightarrow (CdS)y(Me\ S)x/(L\text{-}Cys)$$

The optical and photoluminescent properties of the solutions were studied at a temperature of 298±5 K using MDR-4 and USB-650 spectrophotometers (Ocean Optics). The optical density of the solutions was measured in the range of 0.01–2 with increasing wavelength in the range of 350–1000 nm.

Results. The study of the optical properties of the synthesized Ag+/CdS/L-Cys heterostructures showed that the addition of Ag+ ions with a concentration greater than$1\cdot10^{-5}$ mol/l leads to a shift of the optical absorption edge to the long-wavelength region. Since the content of Cadmium ions in the synthesized colloidal solution is significantly higher compared to the content of Ag+, both spectral curves reflect the formation of CdS/L-Cys NPs without evidence of Ag_2S formation.

From the optical absorption spectra, it was established that the influence of the concentration of Ag+ ions on the position of the absorption edge of colloidal solutions up to the content of Ag+ ions $6\cdot10^{-5}$ mol/l, within the experimental error, does not significantly affect the optical properties of the CdS colloidal solution. At the same time, the hypsochromic shift λ_{lim} caused by the addition of a minimum amount of Argentum ions ($1\cdot10^{-5}$ mol/l) and the increase in PL intensity may indicate the introduction of an impurity into the semiconductor lattice. At the same time, the admixture acts as a polarizer in relation to sulfide ions.

The increase in the concentration of the formed particles and their size is confirmed by TEM images of NPs from the studied systems and by a calculation method based on the results of the optical characteristics of colloidal solutions.

Conclusion. It was found that the introduction of Ag+ ions into a solution with nanosized CdS particles was found to cause an increase in the luminescence quantum yield compared to the original solution of CdS NPs. The improvement of the luminescence output is caused by the fact that the introduction of impurity ions with a +1 charge contributes to the formation of hybrid structures that participate in energy conversion in the excited state of the system.

Absorption spectra are characterized by a shift of the absorption edge to the long-wavelength region. The absorption edge is not clear, which corresponds to the defectiveness of the obtained systems. In all cases, the introduction of Ag+ impurities causes an increase in the number of formula units included in the composition of the agglomerate. From the obtained results, we can conclude about the possibility of using the obtained CdS/L-Cys colloidal solutions in analytical chemistry as sensors for Argentum ions.