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PHOTOLUMINESCENCE PROPERTIES OF GLUCOSE-BASED CARBON QUANTUM DOTS

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Abstract. This study presents the results of obtaining carbon quantum dots (CQDs) using a hydrothermal method based on the principles of "green" synthesis based on glucose precursor and studying their photoluminescence (PL) properties. During the experiment, the effect of synthesis temperature and time on the size, shape, and optical efficiency of quantum dots was analyzed. Spectral studies revealed that the obtained CQDs emit intensively in the visible region and the dependence of the emission peak on the wavelength of the exciting radiation was determined. Also, high photostability of CQDs and a significant increase in quantum yield (from 17% to 43%) in polymer matrices were observed. The low toxicity, high biocompatibility, and stable optical properties of glucose-based CQDs make them promising nanomaterials for biomedical visualization, luminescent sensors, and optoelectronic devices.

Keywords: Carbon quantum dots, glucose, hydrothermal synthesis, photoluminescence, quantum yield, biocompatibility, nanomarkers.

Glukoza asosida uglerodli kvant nuqtalarining fotolyuminestentsiya xossalari

Annotatsiya. Ushbu tadqiqotda glukoza prekursori asosida "yashil" sintez tamoyillariga tayangan holda gidrotermik usul yordamida uglerod kvant nuqtalarini (CQD) olish va ularning fotolyuminestsentsiya (PL) xossalarini o'rganish natijalari keltirilgan. Tajriba davomida sintez harorati va vaqtining kvant nuqtalarining o'lchami, shakli hamda optik samaradorligiga ta'siri tahlil qilindi. Spektral tadqiqotlar natijasida olingan CQDlarning ko'rinadigan sohada intensiv nurlanishi va emissiya cho'qqisining qo'zg'atuvchi nurlanish to'lqin uzunligiga bog'liqligi aniqlandi. Shuningdek, CQDlarning polimer matritsalar ichida yuqori fotostabilligi va kvant unumining sezilarli darajada ortishi (17% dan 43% gacha) kuzatildi. Glukoza asosidagi CQDlarning past toksikligi, yuqori biomoslashuvchanligi va barqaror optik xossalari ularni biotibbiy vizualizatsiya, lyuminestsent sensorlar va optoelektronik qurilmalar uchun istiqbolli nanomaterial sifatida namoyon etadi.

Kalit so'zlar: Uglerod kvant nuqtalari, glukoza, gidrotermal sintez, fotolyuminessensiya, kvant unumi, biomoslashuvchanlik, nanomarkerlar.

Свойства фотолюминесценции углеродных квунтов на основе глюкозы

Аннотация. В данном исследовании представлены результаты получения углеродных квантовых точек (УКТ) гидротермальным методом, основанным на принципах

«зеленого» синтеза с использованием глюкозного прекурсора, и изучены их фотолюминесцентные (ФЛ) свойства. В ходе эксперимента был проанализирован эффект температуры и времени синтеза на размер, форму и оптическую эффективность квантовых точек. Спектральные исследования показали, что полученные УКТ интенсивно излучают в видимом диапазоне, и была определена зависимость пика излучения от длины волны возбуждающего излучения. Также наблюдалась высокая фотостабильность УКТ и значительное увеличение квантового выхода (с 17% до 43%) в полимерных матрицах. Низкая токсичность, высокая биосовместимость и стабильные оптические свойства УКТ на основе глюкозы делают их перспективными наноматериалами для биомедицинской визуализации, люминесцентных датчиков и оптоэлектронных устройств.

Ключевые слова: Углеродные квантовые точки, глюкоза, гидротермальный синтез, фотолюминесценция, квантовый выход, биосовместимость, наномаркеры.

Introduction. In the last decade, zero-dimensional (0D) nanostructures, in particular carbon quantum dots (CQDs), have attracted much attention in nanotechnology and materials science due to their unique physicochemical properties. Carbon quantum dots (CQDs) are nanocrystals typically smaller than 10 nm in size, and they are distinguished by their superior biocompatibility, low toxicity, chemical stability, and ease of synthesis compared to conventional semiconductor quantum dots (e.g., CdSe, PbS) [1-3]. One of the most attractive properties of CQDs is their high photoluminescence capability. Their emission spectrum depends not only on the particle size but also on the surface functional groups and the excitation wavelength, which opens up wide possibilities for their application in biomedical imaging, luminescent sensors, targeted drug delivery, and optoelectronic devices [4].

Currently, hydrothermal, microwave and pyrolysis methods are widely used in the synthesis of CQDs based on the “bottom-up” principle. Various organic compounds can be used as precursors. However, due to the requirements of environmental safety and sustainable development, obtaining nanomaterials from natural sources based on the principles of “green” chemistry is gaining importance. Glucose is considered the most promising and environmentally friendly raw material for the synthesis of CQDs due to its widespread distribution in nature, its recyclability and the large number of carbon and oxygen functional groups in its composition [5-6].

Carbon dots are distributed in nature in various forms (figure 1). In particular, Graphene quantum dots (GQDs): are small fragments consisting of single or multi-layer graphene sheets, with a clear crystal lattice structure and characteristic chemical groups at their edges or in interlayer defects. Carbon quantum dots (CQDs): have a mainly spherical morphology and are characterized by a crystal lattice and functional chemical groups clearly visible on the surface. Carbon nanodots (CNDs): are nanostructures that, although characterized by a high degree of carbonization, generally do not have a clear crystal lattice structure and polymer properties [7].

Increasing the luminescence efficiency of glucose-based CQDs and controlling their optical properties remains an urgent scientific task. It is known that the photoluminescence properties of CQDs are highly sensitive to their surface state and dispersion medium. In particular, their incorporation into polymer matrices (e.g., PMMA or polyvinyl alcohol) allows not only to passivate the surface of nanocrystals, but also to significantly increase the quantum yield [9].

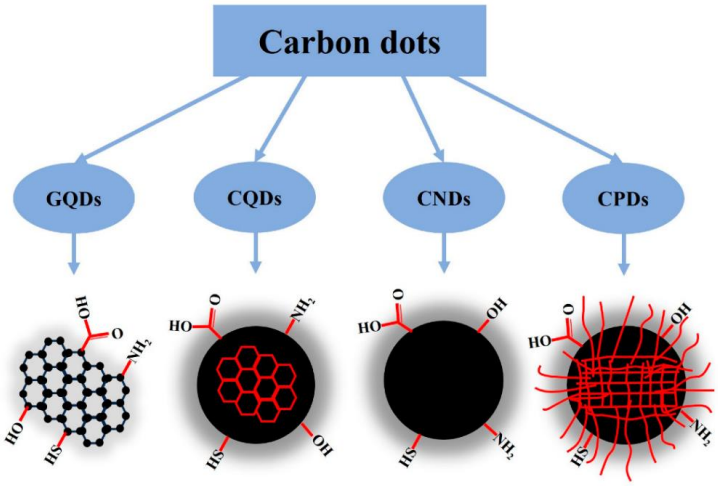

Figure 1. Classification of carbon-based dots: graphene quantum dots, carbon quantum dots, carbon nanodots, and carbonized polymer dots [8]

The aim of this study is to synthesize carbon quantum dots from glucose precursors using a hydrothermal method, to evaluate the effect of synthesis conditions (temperature and time) on the morphology of nanocrystals, and to conduct a thorough analysis of the photoluminescence properties of the obtained CQDs, including their optical characteristics in a polymer matrix. The results obtained serve as a scientific basis for the application of glucose-based CQDs as new generation nanomarkers and biosensors.

Research Methodology.

Chemicals and Reagents. The following chemicals and reagents were used for the synthesis of CQDs: glucose ($C_6H_{12}O_6$, high purity), distilled water, hydrogen peroxide (H_2O_2, 30%), hydrogen sulfide (H_2S), nitrogen gas (N_2), and, if necessary, acid (e.g., HCl) and alkali (e.g., NaOH) for pH adjustment.

Glucose-based synthesis of carbon quantum dots.

A hydrothermal method was used to synthesize carbon quantum dots based on glucose [10]. First, a certain amount of glucose (e.g., 2 g) was mixed in distilled water (e.g., 100 mL) until completely dissolved. Once a clear solution was formed, other reagents (e.g., hydrogen peroxide, sulfur source, or other nutrients) were added to it if necessary. This mixture was then placed in a fully sealed stainless steel autoclave (e.g., 500 mL volume). The reaction mixture was heated to a controlled temperature (e.g., 130 °C) for 3 h. After the reaction, the autoclave was cooled to room temperature to obtain a black or brown CQD solution. For control and purification purposes, the solution was first separated from the excipients by high-speed centrifugation (e.g., 7000 rpm, 15 min). Subsequently, if necessary, washing with organic solvents such as CH_2Cl_2 (chloroform) or acetone and centrifugation again (e.g., 15,000 rpm, 20 min) were performed. Finally, the purified CQD samples were prepared for further analysis. The synthesis temperature, time, and reagent ratios play an important role in determining the size, morphology, and optical properties of the CQDs, and are discussed in detail in the discussion section of the article.

The synthesis process was carried out in the following steps:

1 g of glucose was dissolved in 20–30 ml of distilled water. The resulting mixture was heated to 50 °C at a speed of 30 °C/min using a magnetic stirrer and stirred intensively for 20–30 min until completely homogeneous. Surface modification: In order to improve the luminescent properties of CQDs and dope their surface with nitrogen atoms, 0.5–1.0 ml of ethylenediamine (EDA) was added to the solution. Hydrothermal treatment: The prepared homogeneous solution was placed in a Teflon-lined stainless steel autoclave. The synthesis process was carried out in a closed system at a temperature range of 180–200 °C for 6–8 h. Under these hydrothermal conditions, nanoscopic-sized carbon quantum dots were formed as a result of dehydration, polymerization, and carbonization of the precursors. After the reaction was completed, the autoclave was naturally cooled to room temperature. Taking into account the high pressure inside the system, safety precautions were strictly observed during sample extraction.

The following methods were used to determine the structural, optical, and morphological properties of the resulting carbon quantum dots: Photoluminescence spectroscopy: Determination of the emission spectrum, emission peak position, and quantum yield. UV-Vis absorption spectroscopy: Study of the absorption characteristics and excitonic transitions of the material. FTIR spectroscopy: Identification of functional groups on the surface.

Analysis results. The resulting solution was light yellow in color, and the sample exhibited strong blue-green photoluminescence under excitation UV (365nm) light. The addition of EDA to the sample resulted in the formation of nitrogen-enriched CQDs, which led to an increase in their emission intensity and quantum yield (Figure 2).

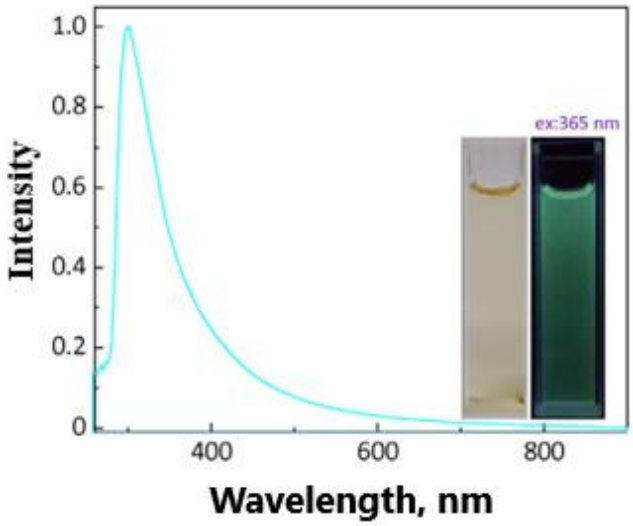

Figure 2. UV absorption spectra of carbon quantum dots

The absorption spectrum of CQDs shows a prominent peak at 450 nm (Fig. 3a). Typically, the absorption in the 230–280 nm region of carbon quantum dots is due to π→π× transitions of C=C bonds, while the absorption in the 300–450 nm region is due to n →π× transitions of electrons in surface functional groups (e.g., C=O or C=N).

In our case, the peak at 450 nm is due to nitrogen-containing functional groups and surface defect states formed as a result of surface modification with ethylenediamine (EDA). When CQDs are excited with 450 nm radiation, the maximum emission peak corresponds to a wavelength of 471 nm (blue-green region) (Fig. 3b). The relatively narrow emission spectrum (FWHM) indicates that the nanocrystals are monodisperse in size and that surface states dominate during irradiation. The difference between the absorption and emission peaks (Stokes shift) is about 21 nm. This relatively small shift indicates low energy loss and high radiation efficiency (high quantum yield).

The quantum yield of carbon quantum dots was calculated using the maximum of the absorption spectra. High photostability of CQDs in PMMA polymer matrices and a significant increase in quantum yield (from 17% to 43%) were observed.

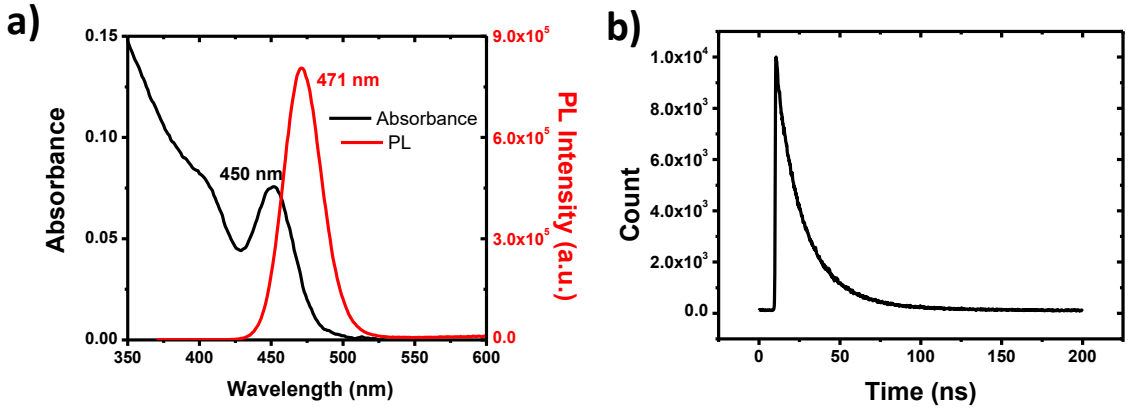

Figure 3. Optical absorption, photoluminescence spectra (a) and time-dependent decay curves of glucose-based CQDs are presented

The time decay of the emission intensity occurs in the nanosecond (ns) time scale (from 0 to 200 ns). The appearance of the graph shows that the decay process obeys a multi-exponential law. This indicates that several types of recombination mechanisms are involved in the emission process: Recombination of excitons in the central part of the nanocrystals. Return of electrons trapped in "traps" in surface functional groups by radiation. The average lifetime (τ_(avg)) of CQDs confirms that they are stable enough for use in biomedical visualization and sensors, and that the emission is mainly of a fluorescent nature.

Conclusion. In this study, carbon quantum dots were successfully synthesized via an environmentally friendly hydrothermal method based on a renewable glucose precursor. Parameters such as synthesis temperature and time were found to play a crucial role in controlling the size, morphology, and optical efficiency of CQDs. Spectral analyses clearly demonstrated that the synthesized CQDs emitted with high intensity in the visible spectrum and that the emission peak was dependent on the excitation radiation wavelength. Importantly, the incorporation of carbon quantum dots into polymer matrices led to a significant increase in their photoluminescence quantum yield (from 17% to 43%) and improved stability against photodegradation; this is explained by the effective passivation of the polymer matrix on the surface of CQDs and the reduction of non-radiative recombination pathways. In conclusion, the low toxicity, high biocompatibility, and stable optical properties of these glucose-based CQDs confirm their extremely promising nanomaterials for biomedical visualization (bio-imaging), highly sensitive luminescent sensors, and next-generation optoelectronic devices.

References

1. Teli S., Soni S., Manhas A., Jha P. C., Agarwal S.. Biomass Derived Carbon Quantum Dots for the Green Synthesis of Aryl Semicarbazones and Their In Silico Evaluation //Chemistry & Biodiversity. – 2026. – T. 23. – №. 1. – C. e03706.
2. Molaei M. J. Carbon quantum dots and their biomedical and therapeutic applications: a review //RSC advances. – 2019. – T. 9. – №. 12. – C. 6460-6481.
3. Pathak T. S., Chattopadhyay J. Green synthesis of carbon-based quantum dots //Carbon Quantum Dots in Biomedical Applications. – Elsevier, 2026. – C. 51-77.
4. Eliboev I., Ishankulov A.F.. Advancing Analytical Chemistry with Carbon Quantum Dots: Comprehensive review //Analytical Methods. – 2025.
5. Das S., Mondal S., Ghosh D. Carbon quantum dots in bioimaging and biomedicines //Frontiers in bioengineering and biotechnology. – 2024. – T. 11. – C. 1333752.
6. Ogochukwu O. O., Fabiyi M. B., Aworunse O. S., Oyewole O. A., and Isibor P. O. (2024). Nanoparticle Properties and Characterization. In Environmental Nanotoxicology: Combatting the Minute Contaminants (pp. 23-40). Cham: Springer Nature Switzerland.
7. Sobirova F., Ishankulov A., Khalilov K. Synthesis, modification, and physicochemical properties of carbon quantum dots //Advanced Materials for Optics and Photonics: Chemistry and Engineering Perspectives (AMOP 2025). – 2025. – T. 14014. – C. 407-411.
8. Guo W. Song, X., Liu, J., Liu, W., Chu, X., Lei, Z.. Quantum dots as a potential multifunctional material for the enhancement of clinical diagnosis strategies and cancer treatments //Nanomaterials. – 2024. – T. 14. – №. 13. – C. 1088.
9. Abd Rani U. U., Ng L. Y., Ng C. Y., Mahmoudi E.. A review of carbon quantum dots and their applications in wastewater treatment //Advances in colloid and interface science. – 2020. – T. 278. – C. 102124.
10. Mohamed W. A. A., Abd El-Gawad H., Mekkey S., Galal H., Handal H., Mousa H., Labib A.. Quantum dots synthetization and future prospect applications //Nanotechnology Reviews. – 2021. – T. 10. – №. 1. – C. 1926-1940.

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