

SECTION XVIII. PHYSICS AND MATHEMATICS

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THE IMPACT OF RADIOACTIVE RADIATION ON THE ELECTRICAL TRANSMISSION PROPERTIES OF GRAPHENE OXIDE (GO)

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Abstract: *Radioactive radiation is a high-energy process that emits high-energy particles and light waves from atoms. This process can alter the atomic structure of materials such as graphene oxide (GO), thus changing their electrical conductivity properties. GO possesses unique features such as a high surface area and high connectivity, which allows for the generation of electric current through the transportation of electrons and holes. Radioactive radiation, by altering the atomic structure, can change the energy levels, conduction band, and even the semiconductor properties of a diode. These changes can affect the light emission spectrum, color, and even the optoelectronic properties of the diode. Consequently, radioactive radiation can be used as a new method to control the light emission properties, color, and even electrical conductivity of GO diodes. This creates new opportunities for the design and application of next-generation optoelectronic devices.*

Introduction

Radioactive irradiation is a process of modifying energy levels that causes the emission of high-energy particles or light waves from certain atomic nuclei. These numerical changes can alter the physical and chemical properties of materials at the atomic and molecular level.

Graphene Oxide (GO) is a unique material that has drawn extensive attention in the scientific community for its remarkable electrical, mechanical, and thermal properties. [6-7, 9] These attributes make GO an excellent candidate for numerous applications, including electronics, energy storage, and sensor technologies. Despite extensive research on the properties and applications of GO, the impact of radioactive irradiation on its electrical conductivity is not fully understood. This is critical, as changes in electrical conductivity could significantly affect the performance of devices using GO.

The electrical conductivity of a material is determined by its ability to transport charges. In the case of GO, its unique structure composed of carbon atoms gives it a special ability to conduct electric current. Radioactive irradiation can interact with this structure, potentially altering its properties and consequently the material's ability to conduct electric current.

Graphene Oxide and Electron Transport Characteristics - Graphene oxide (GO) is an oxygenated version of graphene. Graphene is a two-dimensional material made up of carbon atoms one atom thick, and when linked with oxygen atoms, it transforms into graphene oxide, which has new properties.[4] Graphene oxide is

recognized for its high electrical as well as high thermal transport properties. These characteristics create a broad "band gap" for electrons to move freely, resulting in unique electron transport properties in graphene oxide. The band gap is the difference between energy levels in a semiconductor, where electrons must overcome this energy difference to transition from the valence band (limited energy level) to the conduction band (higher energy level). The size of the band gap determines the material's electronic properties, especially its electrical conductivity.[5,17,18] The electron transport properties of graphene oxide depend on its structure and the placement of oxygen atoms. Oxygen atoms disrupt the precise symmetric structure of graphene, which alters the movement of electrons. This defines the semiconducting properties of graphene oxide, making it attractive for numerous applications, including diodes, transistors, and other electronic devices.

The electron transport properties of graphene oxide are determined by the physical structure of the material, its chemical composition, and the bond system. These factors determine how graphene oxide controls electron movement and thus its electron transport properties. This is a crucial factor in the operation of diodes, transistors, and other semiconductor devices.

These unique properties of graphene oxide open up new opportunities in the fields of nanotechnology and nanoelectronics. [12-16] This allows for the development of new types and higher-performance electronic devices. For instance, the electron transport properties of graphene oxide make it an ideal material for electronic devices, especially diodes and transistors.

The impact of radioactive irradiation on the electrical transmission properties of graphene oxide (GO) is a compelling research topic. Understanding this process paves the way for intriguing and necessary knowledge in the fields of physics, chemistry, and materials science. Such investigations could open doors for wider applications of GO, as well as the development of new technologies.

Graphene oxide is the oxidized form of graphene, a layer of carbon atoms with the thickness of an atom. This oxidation alters the material's electron structure, even its electrical transmission properties. GO largely exhibits semi-conductive properties, making it an ideal material for the transport of electrical current through the conveyance of electrons and vacancies (holes).

Diodes are devices used for directing electrical current in one direction and emitting light. Diodes made from GO are distinguished by their electrical transmission properties. Therefore, these devices encompass both light emission and electrical current transport features.[5-11]

Radioactive irradiation, being a process of releasing high energy particles or light waves from atomic nuclei, can alter a material's atomic structure and, consequently, its electrical transmission properties. When graphene oxide diodes are exposed to radioactive irradiation, it is possible to alter the fundamental electron structure of these devices, leading to changes in their light emission and electrical current transport properties.

Changes in the electrical transmission properties of graphene oxide diodes can alter their light emission spectrum, color, and the "jump" of electrons from the conduction band to the valence band. This allows for a change in the color and light emission power of the diodes, thereby paving the way for new LED applications.

Radioactive irradiation is a process that liberates energy, causing the release of high-energy particles or light waves from atomic nuclei. This energy can alter the atomic structure of materials and, consequently, change the electronic

properties of a material. As an example, we could consider the electrical conductivity of a graphene oxide diode (GO diode).[5, 9, 13]

Graphene oxide is characterized by an atomic structure composed of carbon atoms, boasting numerous unique properties, including high connectivity, high surface area, and the transport of electrons and holes (absence of electrons) that facilitate the generation of an electric current. Electrons and holes play a central role in generating an electric current. When electrons "jump" from the conduction band (an energy level under pressure) to the valence band (an energy level where electrons are usually situated), energy is released, appearing as light energy. This process leads to light emission from diodes.

Radioactive irradiation can alter the electrical conductivity of a GO diode as it provides enough energy to release particles from atomic nuclei. These particles can modify the atomic structure and, as a result, change the electronic properties of the diode. This can alter the diode's energy levels, conduction band, and even its semi-conductive properties. For instance, if energy levels are changed, this could alter the light emission spectrum and color of the diode.

Finally, radioactive irradiation can also open new applications for GO diodes. We can change the light emission spectrum and color of the diode by controlling the irradiation period and degree. This can lead to a new type of LED application. This is seen as a significant opportunity for the design and application of next-generation optoelectronic devices.[3,8,10]

In addition, this effect of radioactive irradiation could aid in the creation of a new optoelectronic device that could emit light across a broader spectrum. This is essentially a process that changes the color of the diode and alters its optical properties. This could create a new diode application capable of emitting light across a wide spectrum.

Research on radioactive irradiation explores how it can change a diode's electronic properties, primarily its electrical conductivity.[1,2] These studies are crucial for the design and application of next-generation semiconductor devices. We will now clarify the meaning of this research by demonstrating this concept in a wide application table.

Table 1

Examples of Radioactive Irradiation Altering the Electrical Conductivity of Graphene Oxide Diodes

Application	Explanation
Optoelectronics	Graphene oxide is known for its high electrical conductivity and semiconductor properties. With radioactive irradiation, these features can be modified, paving the way for the creation of new types of optoelectronic devices such as LEDs, photodiodes, and optical sensors.
Energy Production and Storage	The electrical conductivity of graphene oxide has extensive applications in energy production and storage. Radioactive irradiation can alter these properties, potentially enhancing the efficiency of energy production or making energy storage systems more effective and reliable.
Sensor Technologies	The electrical conductivity of graphene oxide allows sensors to operate more effectively. With radioactive irradiation, these properties can be modified, allowing sensors to be more precise and sensitive.
New Materials and Nanotechnology	Graphene oxide, with its atomic scale structure and unique electrical properties, is an attractive material for nanotechnology. Radioactive irradiation can change these properties, which can lead to the development of new materials and advancements in nanotechnology.

Table 1 demonstrates the broad possibilities that the concept of radioactive irradiation's potential to modify the electrical conductivity of graphene oxide diodes can offer for new applications. This opens up unexpected opportunities for the design and application of next-generation semiconductor devices. Essentially, radioactive irradiation alters the electrical conductivity of the material, which can create various design and application possibilities for next-generation semiconductor devices. [7,9,14,19] These devices can find widespread applications in various fields, from energy production and optoelectronics to sensor technologies.

Conclusion

This article investigates the effect of radioactive irradiation on the electrical conductivity of graphene oxide (GO) diodes.[3] Research shows that radioactive irradiation alters the electronic properties of GO diodes. This effect can change the energy levels, transmission band, and even the semiconductor properties of the diode. These changes can alter the diode's light emission spectrum and color.

The main findings of the article are as follows:

1. Changes in Energy Levels: Radioactive irradiation can change the energy levels of the diode. This can alter the diode's light emission spectrum and color, opening up possibilities for new applications.

2. Changes in the Transmission Band: Radioactive irradiation can change the transmission band of the diode. This change can alter the electrical transmission properties of the diode, which can in turn change the diode's light emission and electrical current transmission.

3. Changes in Semiconductor Properties: Radioactive irradiation can change the semiconductor properties of the diode. This can alter the material's electronic properties, which is crucial for the design and application of next-generation semiconductor devices.

4. Potential for New Applications: Radioactive irradiation can open up new applications for GO diodes. [2-5] We can change the diode's light emission spectrum and color by controlling the duration and degree of irradiation. This could open up a new application for LEDs of its kind.

These results enhance our understanding of how radioactive irradiation can impact the electrical transmission properties of graphene oxide diodes. This is extremely valuable for the design and application of next-generation semiconductor devices. These devices can find broad applications in various fields, ranging from energy production to optoelectronics.

References:

- [1] E.A. Khanmamedova, Electrical conductivity properties of graphene oxide, NO. 32(151) (2023): 7TH ISPC «CURRENT ISSUES AND PROSPECTS FOR THE DEVELOPMENT OF SCIENTIFIC RESEARCH» (APRIL 19-20, 2023; ORLÉANS, FRANCE). <https://archive.interconf.center/index.php/2709-4685/article/view/3099>
- [2] Khanmamedova E.A., Analysis of electrical conductivity in nanotransistor structures with graphene oxide nanofibers, V International Scientific and Practical Conference «THEORETICAL AND EMPIRICAL SCIENTIFIC RESEARCH: CONCEPT AND TRENDS» p.-152-155, June 23, 2023; Oxford, UK. <https://archive.logos-science.com/index.php/conference-proceedings/issue/view/12/12>
- [3] Khanmamedova E.A., Abaszade R. G., Safarov R.Y., Namazo R.A.-Graphene-based transistors, Ecoenergetics, №2, pp.52-57, 2023. http://ieeacademy.org/wp-content/uploads/2023/06/Ecoenergetic_-N2-2023-full.pdf
- [4] Khanmamadova E.A., Diodes made from carbon nanotubes, International scientific journal «Grail of Science» |No29(July, 2023), p. 225-229. <https://archive.journal-grail.science/index.php/2710-3056/article/view/1447>

- [5] R.G. Abaszade, A.G. Mammadov, V.O. Kotsyubynsky, E.Y. Gur, I.Y. Bayramov, E.A. Khanmamedova, O.A. Kapush, Photoconductivity of carbon nanotubes, *International Journal on Technical and Physical Problems of Engineering*, Vol.14, №3, pp.155-160, 2022. <http://www.iotpe.com/IJTPE/IJTPE-2022/IJTPE-Issue52-Vol14-No3-Sep2022/21-IJTPE-Issue52-Vol14-No3-Sep2022-pp155-160.pdf>
- [6] E.A. Khanmamedova, THERMAL PROCESSING ANALYSIS OF GRAPHENE OXIDE, April 28, 2023; Seoul, South Korea: II International Scientific and Practical Conference «THEORETICAL AND PRACTICAL ASPECTS OF MODERN SCIENTIFIC RESEARCH» <https://archive.logos-science.com/index.php/conference-proceedings/article/view/714>
- [7] Khanmamedova E.A., Schematic representation of the preparation of graphene oxide, *Ecoenergetics*, №1, pp.63-67, 2023. <http://ieeacademy.org/wp-content/uploads/2023/03/Ecoenergetics-N1-2023-1.pdf>
- [8] Liu, J., Fu, S., Yuan, B., Deng, Z., & Shen, M. (2010). Facile synthesis of graphene oxide and its reduction. *Journal of Materials Chemistry*, 20(35), 7491-7496. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6628170/>
- [9] R.G.Abaszade, A.G.Mamedov, I.Y.Bayramov, E.A.Khanmamedova, V.O.Kotsyubynsky, O.A.Kapush, V.M.Boyчук, E.Y.Gur, Structural and electrical properties of sulfur-doped graphene oxide/graphite oxide composite, *Physics and Chemistry of Solid State*, Vol.23, №2, pp. 256-260, 2022. <https://doi.org/10.15330/pcss.23.2.256-260>
- [10] E.A. Khanmamedova, MATHEMATICAL MODEL ANALYSIS OF GRAPHENE OXIDE THERMAL DEVELOPMENT, No. 26 (2023): I CISP Conference «SCIENTIFIC VECTOR OF VARIOUS SPHERE' DEVELOPMENT: REALITY AND FUTURE TRENDS» <https://archive.journal-grail.science/index.php/2710-3056/article/view/1145>
- [11] Avouris, P. (2010). Graphene: Electronic and Photonic Properties and Devices. *Nano Letters*, 10(11), 4285–4294. <https://pubs.acs.org/doi/abs/10.1021/nl102824h>
- [12] E.A. Khanmamedova, X-ray analysis of graphene based materials, *Proceedings of the 7th International Scientific and Practical Conference «Current Issues and Prospects for The Development of Scientific Research»* (April 19-20, 2023). Orléans, France <https://archive.interconf.center/index.php/2709-4685/article/view/3100>
- [13] N. A. Guliyeva, R. G. Abaszade, E. A. Khanmamedova, E. M. Azizov, Synthesis and analysis of nanostructured graphene oxide, *Journal of Optoelectronic and Biomedical Materials* Vol. 15, No. 1, January - March 2023, p. 23 – 30. https://chalcogen.ro/23_GuliyevaNA.pdf
- [14] Zhang, Y., Tan, Y. W., Stormer, H. L., & Kim, P. (2005). Experimental observation of the quantum Hall effect and Berry's phase in graphene. *Nature*, 438(7065), 201-204. <https://arxiv.org/abs/cond-mat/0509355>
- [15] Kim, F., Cote, L. J., Huang, J. (2012). Graphene Oxide: Surface Activity and Two-Dimensional Assembly. *Advanced Materials*, 22(17), 1954–1958. https://scholar.google.com/citations?hl=th&user=sbflJqUAAAAJ&view_op=list_works&sortby=pubdate
- [16] Ju, L., Geng, B., Horng, J., Girit, C., Martin, M., Hao, Z., Bechtel, H. A., Liang, X., Zettl, A., Shen, Y. R., & Wang, F. (2011). Graphene plasmonics for tunable terahertz metamaterials. *Nature nanotechnology*, 6(10), 630-634. <https://pubmed.ncbi.nlm.nih.gov/21892164/>
- [17] Katsnelson, M. I., & Geim, A. K. (2008). Electron scattering on microscopic corrugations in graphene. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 366(1863), 195-204. <https://www.jstor.org/stable/i25190665>
- [18] R.G. Abaszade, A.G. Mammadov, V.O. Kotsyubynsky, E.Y. Gur, I.Y. Bayramov, E.A. Khanmamedova, O.A. Kapush, Photoconductivity of carbon nanotubes, *International Journal on Technical and Physical Problems of Engineering*, Vol.14, №3, pp.155-160, 2022. <http://www.iotpe.com/IJTPE/IJTPE-2022/IJTPE-Issue52-Vol14-No3-Sep2022/21-IJTPE-Issue52-Vol14-No3-Sep2022-pp155-160.pdf>
- [19] Peigney, A., Laurent, C., Flahaut, E., Bacsa, R. R., & Rousset, A. (2001). Specific surface area of carbon nanotubes and bundles of carbon nanotubes. *Carbon*, 39(4), 507-514. [https://www.scrip.org/\(S\(351jmbntv-nsjt1aadkposzje\)\)/reference/referencespapers.aspx?referenceid=1135853](https://www.scrip.org/(S(351jmbntv-nsjt1aadkposzje))/reference/referencespapers.aspx?referenceid=1135853)