VOLUME 8 ISSUE 1 2022

ISSN 2454-3055

INTERNATIONAL JOURNAL OF ZOOLOGICAL INVESTIGATIONS

Forum for Biological and Environmental Sciences

Published by Saran Publications, India

International Journal of Zoological Investigations Vol. 8, No. 1, 50-54 (2022)

International Journal of Zoological Investigations
Contents available at Journals Home Page: www.ijzi.net
Editor-in-Chief: Prof. Ajai Kumar Srivastav
Published by: Saran Publications, Gorakhpur, India

ISSN: 2454-3055

Oncological Applications of Graphene Based Nanomaterials

Samuel Jawahar B.[1*] and Princess Rajendran A.[2]

[1]Department of Zoology, St. Johns College, Palayamkottai, Tirunelveli, Tamil Nadu, India
[2]Department of Zoology, Rani Anna Government College for Women, Tirunelveli, Tamil Nadu, India

**Corresponding Author*

Received: 14th December, 2021; **Accepted:** 2nd January, 2022; **Published online:** 7th January, 2022

https://doi.org/10.33745/ijzi.2022.v08i01.007

Abstract: Emerging concept in grapheme (Gr)-based nanomaterials (NM's) provides the ability to compliment the constraints of traditional pharmacopoeia by concurrently addressing the cancers (CA's) to the cancer (CA) cell by reducing the side effects of other routes of administration. Gr with its remarkable electronic properties, such as a broader surface region and surface alteration possibilities, will attack the tumour cell effectively. Nano carriers (NC's) also benefit from an adulteration of immune clearance of the physical chemical properties of CA medicines. Medicine can be delivered by means of biodegradable NC's including proteins, peptides, biocompatible polymers, antibodies, conjugates of polymers and more. Gr-supported drug delivery (DD) systems also facilitate combined delivery of therapeutic agents in CA therapy, as an additive or synergistic therapeutic effective co-delivery solution that reduces harmful effects.

Keywords: Graphene, Oncological effects, Drug delivery, Nanotechnology

Citation: Samuel Jawahar B. and Princess Rajendran A.: Oncological applications of graphene based nanomaterials. Intern. J. Zool. Invest. 8 (1): 50-54, 2022.
https://doi.org/10.33745/ijzi.2022.v08i01.007

Introduction

Nanotechnology (NT) is used in order to create better, more precise instruments and treatments with current advantages for cancer (CA) patients and thereby reduce the efficacy of medications and enhance the emphasis (Al-Ani *et al.*, 2017). NT has traditionally been able to provide very successful treatments to CA cells, in particular or preferentially. In reality, a strong anti-cancer (ANC) treatment is taken and packed in a nanoparticle (NP) that brings it to the site of the CA by minimising healthy cell damage (Chen *et al.*, 2015). This was achieved with the first NT-based drugs - CA targeting and less cytotoxic therapy (Moustaoui *et al.*, 2016).

A strong early example of this is a liposome, an axial lipid NP with the potential to encapsulate hydrophile therapeutic agents such as doxorubicin and hydrophobic molycles, such as paclitaxel (PTX), in two different compartments (Caffo *et al.*, 2016). The "filled" liposome will also be used in the patient's cancer cells (CC's), meaning that the drug enters only CC's, and not in healthy cells in the surrounding region. An alternative example is the use of neurosurgical iron oxide NP's, which are inserted into brain tumours (BTR) to increase the healing effects of radiation therapy (RT) (Mehra *et al.*, 2018).

In addition, NT helps increase the precision of Magnetic Resonance Imaging (MRI) and Computed Tomography (CT) scans (Liu *et al.*, 2016). NP's emitting even more precise signals will deepen the tissue and identify tumours and lesions and improve treatment accuracy (Papi, 2021). A wide range of applications are being investigated (Rahman *et al.*, 2015).

Graphite (GP) is like a text, and graphene (Gr) are like any page in the book. One may then remove a flake, remove a page, and this is Gr, just as in a text. In reality, GP is not the only book-like stuff; maybe, there are 1,000 or maybe 2,000, perhaps more stuff that is exactly laid out like a novel (Jang *et al.*, 2018).

In Europe, United States, Asia, Japan and elsewhere in the world Gr is at the forefront of an immense scientific project so as to transport this unique substance from the lab to the factory floor (Menaa *et al.*, 2015). The qualities of Gr are peculiar, and it is the best substance to be produced. It is not possible to make the material smaller than an atom; it is the hardest, it is more effective than diamonds, it is very stretchable (Yang *et al.*, 2019).

The high Gr strengths can be mixed with polymers in order to create even stronger polymer composites than normal. However, they can also be electrically powered at the same time. This can also be very significant, for example, aircraft where the bulk of the construction is composite now for a day (Moezi and Mirzaei, 2021). There are connections between parts of the plane and there is no need to collect energy in those connections and to cause problems. Creation of Gr glue allows electrical conductivity while allowing strong mechanical properties (Mohammadpour and Majidzadeh, 2020).

In nanomedicine (NMC) research it is an increasingly important field to identify biomedical uses for Gr and Gr-related 2D content, but obviously at an early stage. There were no clinical trials in any oncology field using Gr and 2D materials. One of the main findings in our lab is the inherent affinity with the internal Gr and Graph Oxide (GO), the macrophages (MP), the specialised cells that help the identification and elimination of bacteria in the organism. *In vivo*, or *in vitro* culture, MP can absorb GO flakes in a tissue very effectively (Li *et al.*, 2020).

The question is then this: What if Gr is still attached to therapeutic agents, or what about some type of biomolecules of the antigen on the surface? Many researchers are now seeking to establish therapeutic methods and therapies focused on this very effective MP internalisation against brain CA (Joe, 2014).

Researchers at Illinois University in Chicago have shown that this can also be helpful in detecting CC's. In an experiment, brain cells taken from moustaches were mounted on a Gr sheet and it was observed that a single CC's was distinguishable from a standard cell (Mattei and Rehman, 2014). Other researchers at the University of Texas in Austin have created temporary Gr tattoos which monitor the vital signs of an individual, such as his or her skin temperature and hydration (Krasteva *et al.*, 2019).

Gr can be used in medicine extensively. The CA therapies are one of the most important applications. Functionalized nano-sized Gr was proposed to be used as a medicinal carrier for intracellular *in vitro* delivery of chemotherapy ANC drugs. To date nanoGr has been used in the successful ablation of tumours (TR) in the mouse models with a biocompatible PEG coating (Yang *et al.*, 2018).

Gr-based biosensors are also designed for the electrical identification of *Escherichia coli* bacteria, close to the microfluidic chip (MFC). A variety of drug molecules can also be bound to the Gr surface and can thus be used to attack diseases on cell surfaces during DD (Loh *et al.*, 2018).

Furthermore, a modern MFC that is built on the GO will arrest blood TR cells and encourage further analyses of these. If this system has been finished, it may be used for the diagnosis of CA, as well as treatment choices without biopsy, the avoidance of patient pain and risk of infection following biopsy. This ground-breaking device may also be used to study/determine simple biological processes by which CC's metastasize or propagate to remote organs (Rong *et al.*, 2014).

Silver (Ag) is commonly used as a covering for chemotherapy (CHT) surgical devices. This silver (Ag) coating will disrupt medications. Researchers have also discovered a Gr coating to improve the effects of CHT. CHT typically requires an intravenous catheter to the patient administering medication. These catheters are coated with silver (Ag) lining which is antibacterial to avoid bacterial growth and harmful infections in a treatment, as well as the equipment connected to them (Sundaram *et al.*, 2020). Researchers at the Department of Physics at the NTNU are researching what occurs in interaction with the various medications (Mattei, 2014).

Silver (Ag) disrupts CHT medications. Justin Wells, a partner NTNU Physics Professor says-- "The tubing used in intravenous catheters needed to identify possible cause of problems. One probability was an association between the coating and medicines. CHT medications are active agents, but it is impossible to picture the drug interacting with silver (Ag)" (Alberti, 2012). Wells and his students have been looking at surface chemistry with x-ray photoemission spectroscopy (XPS) of one of the most effective chemotherapy products, 5-Fluorouracil and its association with the kind of silver coating used in medical equipment (Bugárová *et al.*, 2019).

The antibacterial silver (Ag) coating completely breaks the drugs with an XPS instrument in Synchrotron Laboratory MAX IV in Sweden. This not only decreases the symptoms of a chemical treatment but produces hydrogen fluoride, which can be damaging for patients and medical instruments as well (Rahman *et al.*, 2019).

Wells said-- "There are reactions that have never been studied, as we know, before between CHT medications and those with which medication comes into touch,". Drugs are still believed to be fully intact throughout the body. The group continued its XPS instrument research, which examined how the same chemical therapy medications with Gr reacted. Gr is a non-reactive element which is occasionally considered to be a magic material which can fix all problems. So we figured it might be a nice match of chemotherapy (Yang *et al.*, 2019).

Gr was already proposed as a cover for medical devices and, according to researchers, thin Gr layers engineered for this use should be feasible. This study provided useful knowledge on the relationship between CHT medicines and the other medicinally contacted compounds. We hope our work will help to improve the efficacy of CA therapy and that we will stay involved in this field (Pramani *et al.*, 2018).

Conclusion

GO is a GP-based, carbon-based NM used to build a drug structure, a 'drug release matrix.' This exciting biomaterial has some special characteristics, such as biocompatibility, wide surface area and chemical stability, ideally suited for the use as a drug delivery device. The researchers have validated the drug-infused NM's versatility through laser deposition techniques. A modern technique that can be used to produce uniform, thin layers of NM such as GO, is matrix-assisted pulsed Laser evaporation (MAPLE). It is based on the pulsed-laser deposition principle, where a high-performance laser beam is guided at the substrate to be deposited. It is like the notion of blowing a stack of sand carefully; the air beam spreads the sand from a single stack to a thin sheet that covers the surrounding area. GO NM's containing CA antibodies were successfully stopped using MAPLE techniques on a solid underlying base.

And if the drugs were embedded in a GO matrix and transported by a laser beam as a thin coating, upload operations have been retained. This kind of functional portal will screen other candidates' medicines. This is an important high-performance approach to assess the efficacy of novel non CA medications and their formulations.

References

Al-Ani LA, AlSaadi MA, Kadir FA, Hashim NM, Julkapli NM and Yehye WA. (2017) Graphene–gold based nanocomposites applications in cancer diseases; Efficient detection and therapeutic tools. European J Med Chem. 139: 349-366.

Alberti C. (2012) From molecular imaging in preclinical/clinical oncology to theranostic applications in targeted tumor therapy. Eur Rev Med Pharmacol Sci. 16(14): 1925-1933.

Bugárová N, Špitálsky Z, Mičušík M, Bodík M, Šiffalovič P, Koneracká M, Závišová V, Kubovčíková M, Kajanová I, Zaťovičová M, Pastoreková S, Šlouf M, Majková E and Omastová M. (2019) A Multifunctional graphene oxide platform for targeting cancer. Cancers 11(6): 753.

Caffo M, Merlo L, Marino D and Caruso G. (2016) Biomedical applications of graphene. Graphene Science Handbook: Applications and Industrialization. Boca Raton, CRC Press, Taylor Francis, pp. 41-56.

Chen Y, Tan C, Zhang H and Wang L. (2015) Two-dimensional graphene analogues for biomedical applications. Chem Soc Rev. 44(9): 2681-2701.

Jang SC, Kang SM, Lee JY, Oh SY, Vilian AE, Lee I, Han YK, Park JH, Cho WS, Roh C and Huh YS. (2018) Nano-graphene oxide composite for in vivo imaging. Int J Nanomed. 13: 221-234.

Joe D. (2014) Microsensors for Chemical and Oncological Applications. Ph.D. Thesis, Faculty of the Graduate School of Cornell University.

Krasteva N, Keremidarska-Markova M, Hristova-Panusheva K, Andreeva T, Speranza G, Wang D, Filipova MD, Miloshev G and Georgieva M. (2019) Aminated graphene oxide as a potential new therapy for colorectal cancer. Oxidative Med Cell Longevity 2019: 3738980.

Li H, Sisoudiya SD, Martin-Giacalone BA, Khayat MM, Dugan-Perez S, Marquez-Do DA, Scheurer ME, Muzny D, Boerwinkle E, Gibbs RA, Chi YY, Barkauskas DA, Lo T, Hall D, Stewart DR, Schiffman JD, Skapek SX, Hawkins DS, Plon SE, Sabo A and Lupo PJ. (2021) Germline cancer predisposition variants in pediatric rhabdomyosarcoma: A report from the children's oncology group. J Natl Cancer Inst. 113(7): 875-883.

Liu Y, Zhong H, Qin Y, Zhang Y, Liu X and Zhang T. (2016) Non-covalent hydrophilization of reduced graphene oxide used as a paclitaxel vehicle. RSC Adv. 6(36): 30184-30193.

Loh KP, Ho D, Chiu GNC, Leong DT, Pastorin G and Chow EKH. (2018) Clinical applications of carbon nanomaterials in diagnostics and therapy. Adv Mater. 30(47): 1802368.

Mattei TA. (2014) How graphene is expected to impact neurotherapeutics in the near future. Expert Rev Neurotherap. 14(8): 845-847.

Mattei TA and Rehman AA. (2014) Technological developments and future perspectives on graphene-based metamaterials: a primer for neurosurgeons. Neurosur. 74(5): 499-516.

Mehra NK, Jain AK and Nahar M. (2018) Carbon nanomaterials in oncology: an expanding horizon. Drug Discovery Today 23(5): 1016-1025.

Menaa F, Abdelghani A and Menaa B. (2015) Graphene nanomaterials as biocompatible and conductive scaffolds for stem cells: impact for tissue engineering and regenerative medicine. J Tissue Engineer Regener Med. 9(12): 1321-1338.

Moezi E and Mirzaei M. (2021) Graphene scaffold for tioguanine delivery: DFT approach. Lab-in-Silico 2(1): 25-29.

Mohammadpour Z and Majidzadeh AK. (2020) Applications of two-dimensional nanomaterials in breast cancer theranostics. ACS Biomater Sci Engineer. 6(4): 1852-1873.

Moustaoui H, Movia D, Dupont N, Bouchemal N, Casale S, Djaker N, Savarin P, Prina-Mello A, de la Chapelle ML and Spadavecchia J. (2016) Tunable design of gold(iii)-doxorubicin complex-pegylated nanocarrier. The golden doxorubicin for oncological applications. ACS Appl Mater Interfaces 8(31):19946-19957.

Papi, M. (2021). Graphene-Based Materials: Biological and Biomedical Applications. Int J Mol Sci. 22: 672.

Pramani KA, Jones S, Gao Y, Sweet C, Vangara A, Begum S and Ray PC. (2018) Multifunctional hybrid graphene oxide for circulating tumor cell isolation and analysis. Adv Drug Delivery Rev. 125: 21-35.

Rahman M, Akhter S, Ahmad MZ, Ahmad J, Addo RT, Ahmad FJ and Pichon C. (2015) Emerging advances in cancer nanotheranostics with grapheme nanocomposites: Opportunities and challenges. Nanomed. 10(15): 2405-2422.

Rahman M, Kazmi I, Beg S, Hafeez A, Afzal M, Kumar V, Anwar F and Ahmad FJ. (2019) Functionalized graphene-based nanomaterials for drug delivery biomedical applications in cancer and chemotherapy. In: Nanoparticles in

Pharmacotherapy, William Andrew Publishing, pp. 429-460.

Rong P, Yang K, Srivastan A, Kiesewetter DO, Yue X, Wang F, Nie L, Bhirde A, Wang Z, Liu Z, Niu G, Wang W and Chen X. (2014) Photosensitizer loaded nano-graphene for multimodality imaging guided tumor photodynamic therapy. Theranostics 4(3): 229-239.

Sundaram A, Ponraj JS, Wang C, Peng WK, Manavalan RK, Dhanabalan SC, Zhang H and Gaspar J. (2020) Engineering of 2D transition metal carbides and nitrides MXenes for cancer therapeutics and diagnostics. J Mater Chem. B 8(23): 4990-5013.

Yang, B, Chen Y and Shi, J. (2018) Material chemistry of two-dimensional inorganic nanosheets in cancer theranostics. Chem. 4(6): 1284-1313.

Yang J, Wang F, Yuan H, Zhang L, Jiang Y, Zhang X, Liu C, Li C, Li H and Stenzel M. (2019) Recent advances in ultra-small fluorescent Au nanoclusters toward oncological research. Nanoscale 11: 17967-17980.

Yang W, Deng X, Huang W, Qing X and Shao Z. (2019) The physicochemical properties of grapheme nanocomposites influence the anticancer effect. J Oncology 2019: 7254534.

Zakaria M and Hassan T. (2019) Contemporary pediatric hematology and oncology. IntechOpen, pp. 76. https://www.intechopen.com/