frontiers | Frontiers in Nanotechnology

TYPE Editorial
PUBLISHED 15 August 2023
DOI 10.3389/fnano.2023.1260792

OPEN ACCESS

EDITED AND REVIEWED BY
Jan M. Macak,
University of Pardubice, Czechia

*CORRESPONDENCE
Bijayananda Panigrahi,
bijayananda.panigrahi@gmail.com
Suresh K. Verma,
sureshverma22@gmail.com
Sourav Das,
sddassourav52@gmail.com
Abhishek Kumar,
abhishekbt13@gmail.com

RECEIVED 18 July 2023
ACCEPTED 07 August 2023
PUBLISHED 15 August 2023

CITATION
Panigrahi B, Verma SK, Das S and Kumar A (2023), Editorial: New generation nano-biomaterials and their potential application in drug delivery and bio-sensing.
Front. Nanotechnol. 5:1260792.
doi: 10.3389/fnano.2023.1260792

Editorial: New generation nano-biomaterials and their potential application in drug delivery and bio-sensing

Bijayananda Panigrahi[1]*, Suresh K. Verma[2]*, Sourav Das[3]* and Abhishek Kumar[4]*

[1]Biopioneer Pvt. Ltd., Bhubaneswar, Odisha, India, [2]KIIT School of Biotechnology, Bhubaneswar, Odisha, India, [3]Institute of Life Sciences, Bhubaneswar, Odisha, India, [4]Department of Molecular Microbiology, School of Medicine, Washington University, Saint Louis, MO, United States

KEYWORDS

nanotechnology, nanomaterials, Pd nanoparticles, ZnO nanoparticles, exosome, drug delivery, and cancer

Editorial on the Research Topic
New generation nano-biomaterials and their potential application in drug delivery and bio-sensing

Nanotechnology is a branch of science that alters the structural and physiological nature of materials to produce innovative nanostructure, which is applicable in various scientific domains such as materials science, agriculture, polymer sciences, and many more. However, the approach of nanomaterials synthesis and possible utility in domains of biomedical and biotechnology have improved rapidly. To date, a wide range of novel nanomaterials have been developed and applied in biomedical applications such as drug delivery, gene therapy, anticancer, disease diagnosis, catalytic activity, antimicrobials, and biosensing. Besides these above-mentioned applications, disease diagnosis and disease therapy are practically challenging. Therefore, the innovation of new and novel nanomaterials would be a key aspect both for the Medical scientific community and the prosperity of the society. Three articles that offer the most recent developments and insights in the domains make up this Research Topic. In the Research Topic, the "New generation nano biomaterials and their potential application in drug delivery and biosensing" majority of the issues and concerns have been addressed.

In the present scenario inorganic nanoparticles (NPs) like PdNPs has revolutionized nano-science research and innovations. This is due to the novel or enhanced physicochemical properties exhibited by PdNPs, they possess wide range of applications not only in chemical catalysis, hydrogen sensing, and storage, but also in medicine, photothermal, antibacterial, and anticancer therapies. Various inorganic nanoparticle synthetic methods such as physical, chemical, biogenic synthesis method has been well reported. Its mechanisms for NPs synthesis involving various biogenic raw materials such as plant-mediated, bacteria-mediated, algae-mediated, or fungi-mediated processes are well known. Still the applicability on real life problem needs to be addressed speedily. PdNPs-related synthesis process together with various multi metallic PdNPs (Joudeh et al.) could provide wider scope for our readers to develop, innovate and apply nanomaterials for the wellbeing of society. Additionally, various unsolved problems such as biosensing, catalysis, antimicrobial, antifungal, and anticancer activity could be resolved with the reported green

synthesized/biogenic Pd NPs in near future. Metal-based NPs restrict its application with major focus towards nanomedicine, because of its limited emerging success in clinical trials. Hence, the utilization of green synthesized NPs in personal care products (PCPs) and pharmaceutical sectors has resulted in a thriving market presence. Thus, by focusing on topical applications, these NPs, derived through environmentally friendly synthesis methods, have gathered significant recognition and acceptance within these industries. Thus, the inclusion of such articles in the current edition has the potential to inspire and motivate our readers.

Further, concerns about the potential toxicity of novel nanomaterials have paved the way for the development of safe and eco-friendly NPs. In line with this, ZnO NPs have recently been approved under 'generally recognized as safe (GRAS)' food additive by the US-FDA. In current research these NPs have emerged as a promising option for cancer therapeutics. To investigate the potential of ZnO NPs in cancer therapeutics, multiple approaches including *in vitro*, *in vivo*, and clinical trials were employed to examine their physical, chemical, biological, pharmacokinetic, and pharmacodynamic properties. These studies explored the characteristics and effects of formulated NPs across different dimensions of research. Li et al. mechanistically elucidated the potency of ZnO NPs for inhibiting cell proliferation and promoting cell apoptosis through induction of caspase 3 at very minimal concentration. This detailed report lays the foundation for future studies on numerous cancers signalling pathways and its in-depth analysis towards disease progression and cure. Further studies on novel ZnO nanosheets recommended their applicability in providing and promoting innovative opportunities for cancer therapeutics. Present articles could direct the innovator for understanding the synthesis, characteristics of NPs and their feasibility towards cancer therapeutics. Further, it could be helpful in uplifting research in both *in vitro* and *in vivo* models and their translation toward clinical trials. In addition to metal-based nanomaterials, there is a growing recognition of the potential of nano-sized exosomes as drug delivery vehicles in cancer therapeutics. This emerging field of research highlights the importance of comprehending the use of exosomes as effective tools in the management and treatment of cancer. Additionally, published manuscript provides a critical overview of different bio-engineering approaches employed for exosomes, with much focus on developing designer exosomes for potential cancer therapeutics. However, despite their promising potential, there are several limitations and challenges associated with isolating and purifying natural exosomes. The lack of accurate techniques to characterize exosomal cargo, limited availability of standardized high-scale purification methods, and suboptimal drug loading efficacy deter their widespread applicability in cancer therapeutics. Therefore, various synthetic methods were adopted for producing exosome like delivery vehicles to carry therapeutic cargo and genetic materials for targeting different cells and tissues. A few of these exosome mimicking materials such as liposomes, polymer-based NPs, acid-coated NPs, dendrimers, aptamers, and various other biomolecules are applied in drug delivery process. Due to lack of specificity, immunogenicity, and cytotoxicity, various approaches are still not implemented on clinical setting. Thus, the advancement of engineered exosomes is explained related to precise targeting of various tissue or cell types. Besides, the reported article also highlights the clinical potential of engineered exosomes (Dutta and Paul) and the extensive research gaps. This will ultimately fascinate the scientific community for performing in depth research. In conclusion, the clinical potential of exosomes for carrying chemotherapeutic drugs and display tumour cell specific targeting, could ultimately promote apoptotic cell death and inhibit tumour cell proliferation without harming the normal healthy cells. The mini-review mainly highlighted the research gaps and potential of exosome-based future perspectives on cancer therapeutics owing to their efficacy, scalability, market potential, and therapeutic benefits.

The articles on this Research Topic include all facets of nanomaterials and how they are applicable in anticancer, antibacterial, biosensing, drug delivery, and therapeutic agents. The editors feel that the current range of applications, their limitations and possible research gaps have been sufficiently emphasized through these above-mentioned articles and could definitely inspire the readers to adopt new and emerging research prospects.

Author contributions

BP: Conceptualization, Writing–original draft, Writing–review and editing. SV: Conceptualization, Writing–review and editing. SD: Conceptualization, Writing–review and editing. AK: Conceptualization, Writing–review and editing.

Conflict of interest

Author BP was employed by Biopioneer Pvt. Ltd., India.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note