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RECEIVED 24 May 2024
ACCEPTED 24 June 2024
PUBLISHED 08 July 2024

CITATION

Ullah Z (2024), Editorial: 2022 retrospective,
carbon-based materials.
Front. Mater. 11:1438039.
doi: 10.3389/fmats.2024.1438039

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Editorial: 2022 retrospective, carbon-based materials

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KEYWORDS

carbon, carbon materials, retrospective, graphene, CNTs

Editorial on the Research Topic 2022 retrospective, carbon-based materials

Carbon is a brand element in the field of materials science, well-known for its versatility and unusual characteristics (Inagaki et al., 2014). It has reshaped the materials around us, with better performance for advanced technological applications (Lan et al., 2021). During the last 2 decades, graphene and carbon nanotubes (CNTs) remained the two most extensively used materials in materials science. When carbon in the form of carbon nanostructures, graphene, or carbon nanotubes (CNTs), is combined with other materials, it can significantly enhance their properties particularly the structural, electrical, optical, mechanical, thermal, and magnetic, making them suitable for applications ranging from electronics to environmental, and aerospace (Chowdhury et al., 2018; Gopinath et al., 2021). Carbon materials are considered as essential in all modern research fields where these play a critical role in the development of auspicious technologies and potential solutions for the modern challenges (Chung, 2004; Liang et al., 2008; Balandin, 2011; Zhai et al., 2011; Titirici et al., 2015; Lan et al., 2021).

Figure 1A shows the increasing trends of carbon materials with passage of time. As per Scopus database, the first paper with word “carbon” in title was published in 1863. The number of publications increased significantly from 1970 to 1990. However, these increased exceptionally afterward, and a total number of 50,350 research items were published in 2023. Materials science remained the dominant field for these contributions, following by Chemistry, Engineering, and Physics and Astronomy, as depicted in Figure 1B. It is very important and interesting to mention here that these are publications with only word “carbon” in title; if we search the word(s) “graphene” or “carbon nanotube” in Scopus database, we respectively get the numbers 182,934 and 118,146, which are in addition to papers on “carbon”.

Owing to great significance of carbon materials, a section of Frontiers in Materials has been dedicated to the Carbon-Based Materials. A Research Topic, “2022 Retrospective: Carbon-Based Materials,” was proposed to attribute the contributions of carbon materials. In this Research Topic, five research documents were published. The first research article was published by Karami, et al. on *Conversion of Waste Corn Biomass to Activated Bio-Char for Applications in Wastewater Treatment*. The report demonstrates the conversion of waste corn to biochar which was further investigated for its potential applications. Authors have shown that the adsorption response of activated biochar was comparable to that with typical commercial activated carbon. The resultant product is very important

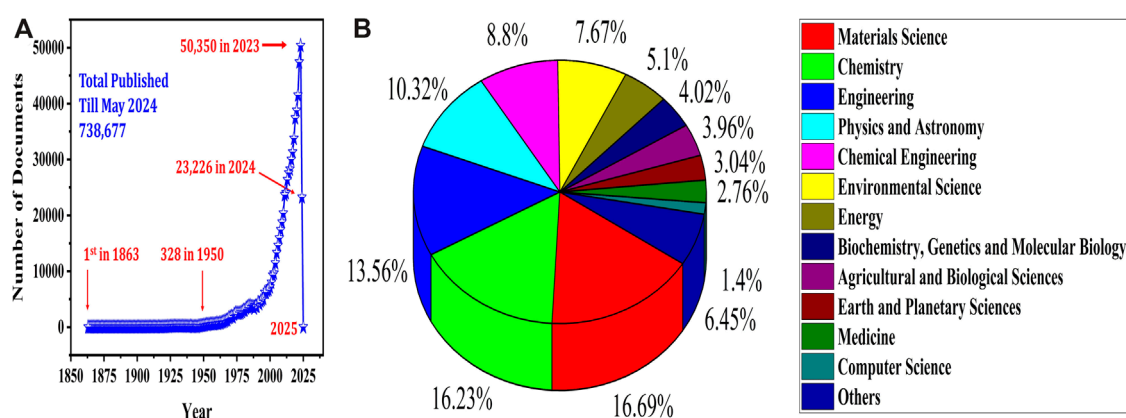


FIGURE 1 (A) Number of documents in Scopus database for keyword "carbon" in document title; (B) key subject areas as per scientific contributions of these publications.

and may offer its auspicious potential particularly in energy applications. The report is very useful for study of biochar assembly through facile and cost-effective methodology.

The second research article was published by [Quqa et al.](#) on *Pressure Mapping Using Nanocomposite-Enhanced Foam and Machine Learning*. The report suggests efficient machine learning strategies (radial basis function networks and deep neural networks) to effectively address the inverse electrical impedance tomography issues. The research is very fruitful in enhancing the resolution of reconstructed pressure maps. It is interesting to mention that the researchers have used carbon nanotubes for device fabrication. The study very beautifully presents the applications of carbon materials in medical domains through machine learning. This report is a good answer to question which may arise in many minds while having a look on [Figure 1](#), that what could be the applications of carbon materials in computer science!

The third article in this Research Topic is a review article published by [Mukherjee et al.](#) on *Synthesis of Biochar From Lignocellulosic Biomass for Diverse Industrial Applications and Energy Harvesting: Effects of Pyrolysis Conditions on the Physicochemical Properties of Biochar*. The article is useful particularly for early-stage researchers that are going to learn the preparation of biochar from biomass for further use in energy applications. The article includes valuable citations for the demonstrated study, and may offer various useful ideas for energy production from biochar at industrial scale. Moreover, the review provides worthy contents for physicochemical features of biochar.

The fourth article was a mini review by [Caballero-Briones et al.](#) on *International research in graphene-oxide based materials for net-zero energy, military and aeronautic applications catalysed by Tamaulipas, Mexico: a mini review*. The article is unique as per its contents ranging from zero energy to aeronautic applications, summarizing the extreme potential of graphene-oxide (carbon), especially for photovoltaic, photocatalytic, thermonuclear, and aeronautic applications. An important aspect of the review is that it highlights the overseas collaborations for leveraging the materials synthesis for desired outcomes.

The final article by [Bumajdad et al.](#) is also a review article on *Nitrogen-enriched activated carbon derived from plant biomasses: a review on reaction mechanism and applications in wastewater treatment*. This article enlightens the process for assembly of carbon from plant biomass which could be very fruitful for researchers working in this area of research with insufficient research facilities and resources. The article has discussions about the methodologies and involved reaction mechanisms for nitrogen enrichment of activated carbon. The review provides valuable findings and deep understandings about basis of the demonstrated study.

Although, the articles in this proposed Research Topic are very limited as per broadness and scope of carbon materials, however, it acknowledges the contributions of carbon materials towards diversity of research directions. The Research Topic could specifically be beneficial for early-stage researchers at academia and industries for their understandings, research trainings and directions for future research particularly on carbon materials for energy applications.

Author contributions

ZU: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Validation, Visualization, Writing—original draft, Writing—review and editing.

Conflict of interest

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

The author declared that they were an editorial board member of *Frontiers*, at the time of submission. This had no impact on the peer review process and the final decision.

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