frontiers in Nanotechnology

EDITORIAL
published: 10 December 2021
doi: 10.3389/fnano.2021.802086

Editorial: Functionally Antagonistic Two-Dimensional Nanomaterials for Advanced Device Technology

Sima Umrao[1], Jaehwan Kim[2], K. Vikram[3] and Qitao Zhou[4]*

[1]Department of Physics, Indian Institute of Science, Bangalore, India, [2]Department of Mechanical System Engineering, Kumoh National Institute of Technology, Gumi, South Korea, [3]Department of Allied Physics, Graphic Era Deemed to be University, Dehradun, India, [4]Engineering Research Center of Nano-Geomaterials of the Ministry of Education, Materials Science and Chemistry China University of Geosciences, Wuhan, China

Keywords: two-dimensional, functionality, triboelectric nanogenerators, photodegradation, halide perovskites

Editorial on the Research Topic

Functionally Antagonistic Two-Dimensional Nanomaterials for Advanced Device Technology

This editorial summarizes the contributions to the Frontiers Research topic "*Functionally Antagonistic Two-Dimensional Nanomaterials for Advanced Device Technology*," established under the nanotechnology for energy applications and nanomaterials section and appearing under the Frontiers in Nanotechnology journals.

For materials scientists and engineers, nanotechnology uses the properties of two-dimensional materials (2D) with the facility of chemical modification, to realize various promising applications. Scientists have also explored the synthesis methods and properties of these materials, which are required for high-performance device technology. Exploiting recent advancements in 2D materials has already led to significant leaps in the materials engineering field. It is therefore of high interest to continue this research to ensure we get the most out of these new advanced 2D materials. These developments, which will have a growing impact on 2D materials in the coming years, require fast and efficient methods to develop materials. This Research Topic aimed to explore recent developments in this area with a focus on 2D materials-based device technology.

In one study, Susmita et al. explored two-dimensional halide perovskite (HP) based optoelectronic devices to describe particularly for solar cell (SC) applications. In this review article, the authors discussed various molecular structures of 2D HP and characterizations to explore crystallographic, morphological, and electrical properties for device optimization. The most unique feature of HP-based SC is the light-absorbing layers, which possess good optimized dielectric constants and exciton binding energy compared to conventional semiconductors. However, 2DHPs based SCs are still facing degradation and stability problems. More experimental and theoretical studies are required to understand and improve the issue of degradation and stability. Although, the scientists made great efforts to study 2D HP materials so that these materials can be used in real practical applications. But, serious attention is needed to create an improved synthesis method with controlled thickness and the large dimensions of 2D HP and to develop large-scale, flexible, functional, and tuneable SCs devices in the future.

In the second study, Ravi et al. developed a Chitosan-PVA (ChS-PVA) Blended 2D Membrane-based triboelectric nanogenerator (TENG), which provides enhanced open-circuit voltage (V_{oc}) and short circuit current (I_{sc}) in comparison to chitosan TENG. ChS-PVA is biodegradable and exhibited a high tensile strength ~15.8 ± 1 MPa. The characterization tools discovered that $–NH_2$ and –OH functional group terminations on the modified Chs-PVA surface aided a good chemical and electrical connection between Chs-PVA and electronegative PVDF. The V_{oc} and I_{sc} of the Chs-PVA TENG were 22 V and 514 nA respectively, which is 633 and 888% larger than Chs TENG. This

OPEN ACCESS

Edited and reviewed by:
*Bingqing Wei,
University of Delaware, United States*

***Correspondence:**
*Sima Umrao
simaphy@gmail.com*

Specialty section:
This article was submitted to Nanotechnology for Energy Applications, a section of the journal Frontiers in Nanotechnology

***Received:** 26 October 2021*
***Accepted:** 29 October 2021*
***Published:** 10 December 2021*

Citation:
Umrao S, Kim J, Vikram K and Zhou Q (2021) Editorial: Functionally Antagonistic Two-Dimensional Nanomaterials for Advanced Device Technology. Front. Nanotechnol. 3:802086. doi: 10.3389/fnano.2021.802086

work showed remarkable energy generation due to the mechanical strong ChS-PVA membrane of the self-powered TENG system.

Another study by Manish et al. reviewed the synthesis of 2D materials (Graphene, h-BN, g-C_2N) from biogenic (rice husk, dead leaves, waste food, etc.) and non-biogenic waste (several types of plastics waste, lard oil, etc.), and their applications. In this article, all waste materials as a precursor are tableted in one place and it discusses all synthesis methods including chemical activation, chemical vapor deposition, electrolysis, and chemical pyrolysis methods, etc. Single layered and multi-layered graphene is well synthesized using the various carbon sources present in plastic waste, paper cups, rice husk, the cellulose acetate present in cigarette butts, waste lard oil, waste cookies, and chocolate, and from empty mosquito repellent refills. The g-C_2N beyond the 2D graphene is synthesized by a self-combustion process using natural aloevera gel collected from aloe vera plants. Biogenic synthesis of the h-BN nanosheets from bulk nanosheets used 17 plant extracts ranging from Hoyenia Dulcis, Panax ginseng, Cercischinensis, and Morus nigra, etc. Additionally, the range of the above discussed 2D material applications is explored, for example, supercapacitors, memristor, oxygen reduction reaction, Adsorbent, Antioxidant Activity, and Nano Fillers for Biopolymer, etc.

In the fourth study, Rohit et al., study the photocatalytic degradation of organic pollutants under visible light using 2D SnS_2 nanostructures (NSs) as a catalyst. In this work, two types of organic dyes including Rhodamine B (Rh. B) and Methyl Violet (M.V) considered textile industry waste in groundwater. SnS_2 NSs synthesized by hydrothermal methods, which possess a low bandgap (~1.6 eV), high surface area (56 m^2/g), and an anionic nature. The main aim of this work was to establish the fast and high photodegradation rate and efficiency under visible light, which may lead to finding a new photocatalyst. The photodegradation efficiency of Rh. B and M.V. in 25 min, are 94 and 99.6% respectively, in the presence of SnS_2 catalyst. The XPS analysis demonstrated the excellent stability of SnS_2 nanostructures for up to five cycles of the photodegradation process.

AUTHOR CONTRIBUTIONS

SU was a Guest Associate Editor of the Research Topic and wrote the paper text. QZ and JK were Guest Associate Editor of the Research Topic and edited the text. KV was a Guest Associate Editor of the Research Topic and edited one paper on the Research Topic.

FUNDING

SU is supported by the Department of Science and Technology (DST), India. JK acknowledges the National Research Foundation of Korea (NRF) for a grant funded by the Korean government (MSIT) (NRF-2021R1F1A1056155).

ACKNOWLEDGMENTS

We thank the authors of the papers published in this Research Topic for their valuable contributions and the referees for their rigorous review. We also thank the editorial board of nanotechnology for energy applications and nanomaterials in the Nanotechnology section, especially Sibo Wang, who acted as an editor for one paper on the Research Topic, and the Frontiers specialists, especially Stamatina Papageorgiou, for their support.

Conflict of Interest: The 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.