applied sciences

MDPI

Editorial

Special Issue on Nano-Electronic Devices and Functional Applications

Chuljin Hwang and Sungjun Park *

Department of Electrical and Computer Engineering, Ajou University, Suwon 16499, Republic of Korea; aki@ajou.ac.kr
* Correspondence: sj0223park@ajou.ac.kr

Nano-electronic devices and materials hold considerable promise due to their inherent structural and material benefits, such as device miniaturization, increased integration density, and reduced power consumption. Streamlined techniques for nano-scale fabrication of these devices and materials, which are compatible with large-scale production and solution processes, help us to further understand their operational mechanisms or their respective formation processes. These advancements have resulted in significant breakthroughs in functional electronic devices, including light-emitting diodes, photodetectors, photovoltaics, transistors, and sensors. In addition, devices that feature flexibility and stretchability offer unprecedented performance for user-friendly electronic applications. This Special Issue is dedicated to discussing the most recent advancements and trends in nano-electronic devices and materials research. It includes a total of seven papers—five original research articles and two review articles as follows.

First, this Special Issue examines methods aimed at enhancing the performance of nano-electric devices by improving their electrical properties. Lin and colleagues [1] proposed a simple and economical thermal passivation method on crystalline silicon wafers under H_2S gas to improve the minority carrier lifetime (up to 2030%). Through surface analysis of the silicon wafers post-annealing, they demonstrated that the quantity of sulfur present is pivotal in dictating the effectiveness of the passivation process. In a separate study, Jee and co-authors [2] propose a two-photon lithography technique for the creation of extensive photonic crystal structures. This method allows the production and control of defects within these repeated photonic crystal structures, thereby enhancing the simple array of patterns traditionally obtained via interference lithography.

Second, this Special Issue features two research papers focused on nano-electronic switching electronics. Han and colleagues [3] reported a new design and the feasibility of a vertical quaternary inverter (QNOT) for four data levels ("1", "2", "3", "4"). Remarkably, this design involves the use of only two field-effect transistors, as verified by a finite-element drift-diffusion simulation. Jeong et al. [4] demonstrated ZnO/ZnS core/shell NW arrays with a significant incensement of output current (from 42.7% to 91.1%). They attributed this increase to the strain-induced piezo-polarization charges present at the ZnO/ZnS core/shell layer, which modulate the energy band structure, and thus enable more efficient charge carrier transport.

Lastly, this Special Issue explores the use of nano-electronic devices as sensors. Kang and colleagues [5] present an overview of the current state of fiber-based electronics, examining their potential for future applications in wearable devices. This review encompasses the architecture, electrical properties, fabrication methods, and applications of these fiber-based electronics. It also addresses the critical challenges facing this technology, along with the practical enhancements required for its widespread adoption. In a separate study, Kim et al. [6] report the successful implementation of amorphous indium–gallium–zinc oxide thin-film transistors on a reverse-trapezoid polydimethylsiloxane substrate, designed to distribute stress for skin-compatible electronic applications effectively. Finally, Lee and

Citation: Hwang, C.; Park, S. Special Issue on Nano-Electronic Devices and Functional Applications. *Appl. Sci.* **2023**, *13*, 6692. https://doi.org/10.3390/app13116692

Received: 24 May 2023
Accepted: 30 May 2023
Published: 31 May 2023

co-authors [7] provide a comprehensive review of the current state and future perspectives of wearable photoplethysmography (PPG) sensors. This is achieved through a systematic literature review, analyzing various semiconducting materials from a skin-compatibility viewpoint.

The ongoing research into nano-electronic devices necessitates an interdisciplinary approach, requiring the convergence of multiple fields. These include, but are not limited to, biology, physics, engineering, optics, material science, computer science, and biomedicine. It is evident that continued collaboration and innovation across these domains will be essential in advancing this promising field.

Author Contributions: Conceived the review, C.H.; writing—original draft preparation, C.H.; writing—review & editing, S.P.; project administration, S.P. All authors have read and agreed to the published version of the manuscript.

Funding: This research was supported by the Korea Electric Power Corporation (Grant No. R21XO01-20). This research was also supported by the Basic Science Research Program through the National Research Foundation of Korea (NRF), funded by the Ministry of Education (NRF-2021R1A6A1A10044950).

Acknowledgments: Thanks to all the authors and peer reviewers for their thoughtful contributions to this Special Issue, 'Applications of Nano-Electronic Devices'.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Lin, J.; Jee, H.; Yoo, J.; Yi, J.; Jeong, C.; Lee, J. Surface Passivation of Crystalline Silicon Wafer Using H_2S Gas. *Appl. Sci.* **2021**, *11*, 3527. [CrossRef]
2. Jee, H.; Park, M.-J.; Jeon, K.; Jeong, C.; Lee, J. Combining Interference Lithography and Two-Photon Lithography for Fabricating Large-Area Photonic Crystal Structures with Controlled Defects. *Appl. Sci.* **2021**, *11*, 6559. [CrossRef]
3. Han, H.; Kim, C.-H. Prediction of a Two-Transistor Vertical QNOT Gate. *Appl. Sci.* **2020**, *10*, 7597. [CrossRef]
4. Jeong, S.; Park, S.-J. Enhanced Electrical Transport and Photoconductivity of ZnO/ZnS Core/Shell Nanowires Based on Piezotronic and Piezo-Phototronic Effects. *Appl. Sci.* **2022**, *12*, 8393. [CrossRef]
5. Kang, M.; Kim, T.-W. Recent Advances in Fiber-Shaped Electronic Devices for Wearable Applications. *Appl. Sci.* **2021**, *11*, 6131. [CrossRef]
6. Kim, K.-T.; Kang, S.-H.; Nam, S.-J.; Park, C.-Y.; Jo, J.-W.; Heo, J.-S.; Park, S.-K. Skin-Compatible Amorphous Oxide Thin-Film-Transistors with a Stress-Released Elastic Architecture. *Appl. Sci.* **2021**, *11*, 5501. [CrossRef]
7. Lee, I.; Park, N.; Lee, H.; Hwang, C.; Kim, J.H.; Park, S. Systematic Review on Human Skin-Compatible Wearable Photoplethysmography Sensors. *Appl. Sci.* **2021**, *11*, 2313. [CrossRef]