

Editorial Interview

Flexible Optoelectronics

THE field of flexible optoelectronics is broad and multidisciplinary, and draws upon knowledge in fields ranging from, amongst others, optics and photonics; organic or inorganic materials; device physics/engineering; nanoscience and nanoengineering; mechanics; neuroscience; signal processing; computing; and bioscience. Research focuses on advancing fundamental knowledge and techniques, as well as applications in diverse areas from communications, sensors to biological engineering. The purpose of this issue is to provide an overview of ongoing progress and trends in advancing the knowledge, understanding, and novel applications of flexible optoelectronics. This special issue addresses the current progress and latest breakthroughs in the flexible optoelectronics and their emergent applications, particularly covering the following areas:

- Flexible light emitting diodes (LEDs) and laser diodes (LDs)
- Flexible photodetectors (PDs), photovoltaics (PVs), and image sensors
- Optical communications/sensors in flexible forms
- Photonic components in flexible forms
- Optoelectronic devices with new materials/structures
- Neuromorphic photonic devices in flexible forms
- Stretchable forms of optoelectronic devices/systems

In this issue, we published a total of 18 papers including six invited papers and 12 contributed papers by authors from diverse countries/regions. The invited papers are from leading experts covering the latest developments in flexible optoelectronics and its applications. These research topics are further explored by many contributed papers.

For instance, Jeonghun Kwak (Seoul National University) and Chih-Chiang Yang (Kun Shan University) report flexible LEDs based on quantum dots and perovskite materials, respectively. Xing Sheng (Tsinghua University) presents micro-LEDs for optogenetic stimulator applications, while Zhi Ting Ye (National Chung Cheng University) shows combination of LEDs and quantum dot color converters for colorimetric sensing applications. Mantu K. Hudait (Virginia Polytechnic Institute and State University) presents design guidelines for monolithically-integrated Ge/InGaAs quantum well lasers. Lan Li (Westlake University) and Subhradeep Pal (BITS-Pilani) report flexible PDs based on InGaAs and organic polymer frameworks, respectively. Changsoo Choi (Korea Institute of Science and Technology) reviews recent advances on flexible and stretchable image sensors for bio-inspired camera modules. Saurabh Pandey (Indian Institute of Technology Patna) report lead-free, high-efficiency perovskite solar cells for flexible

device applications. Lingyao Yu (Guilin University of Electronic Technology) shows Terahertz metamaterial sensors for chiral material detection. Donghyun Kim (Yonsei University) reports curved plasmonic structures based on thermal reflow process. Gil Ju Lee (Pusan National University) reports flexible optical physical unclonable functions (PUFs) based on silver paste textures. Shao-Wei Wang (Shanghai Institute of Technical Physics) show flexible and transparent electrodes for short infrared wave applications. Bo Dong (Shenzhen Technology University) reports flexible polymer optical fibers (POFs) for interferometer applications, while Zhuo Wang (Beijing Normal University) use POFs for wearable cardiorespiratory monitoring. Xianfeng Tang (Beijing University of Posts and Telecommunications) reports a programmable optical logic computing array using dual-drive Mach-Zehnder modulators. Hongseok Oh (Soongsil University) and Joohoon Kang (Sungkyunkwan University) provide experimental results on flexible photosynaptic devices based on vertical ZnO nanotubes and two-dimensional transition metal dichalcogenide, respectively.

Overall, recent advances in flexible optoelectronics technologies have led to diverse applications in flexible sensors, wearable healthcare devices, optogenetics, security platforms, and neuromorphic devices. We hope the papers published in this issue are useful to general audience. Finally, we thank the authors for submitting high-quality papers and the reviewers for providing high-quality reviews of the manuscripts. We acknowledge Prof. Qiaoqiang Gan (Editor-in-Chief) for his generous support, and Alexandra Johnson for the professional service.

YOUNG MIN SONG, *Primary Guest Editor*
Gwangju Institute of Science and Technology
Gwangju, 61005, Republic of Korea
ymsong@gist.ac.kr

YANG CHAI, *Guest Editor*
Hong Kong Polytechnic University
Kowloon, Hong Kong
ychai@polyu.edu.hk

DAE-HYEONG KIM
Seoul National University
Seoul, 08826, Republic of Korea
dkim98@snu.ac.kr

XING SHENG
Tsinghua University
Beijing, 100084, China
xingsheng@tsinghua.edu

DONHEE SON
Sungkyunkwan University
Suwon, 16419, Republic of Korea
daniel3600@g.skku.edu

SEJEONG KIM
University of Melbourne
Melbourne, 3010, Australia
sejeong.kim@unimelb.edu.au



Young Min Song received the B.S. degree in biomedical engineering from Yonsei University, Seoul, South Korea, in 2004, and the M.S. and Ph.D. degrees in information and communications from the Gwangju Institute of Science and Technology (GIST), Gwangju, South Korea, in 2006 and 2011, respectively. From 2013 to 2016, he was an Assistant Professor with the Pusan National University, Busan, South Korea. He is currently a Professor with the School of Electrical Engineering and Computer Science and AI Graduate School, GIST, Gwangju, South Korea. From 2011 to 2013, he was a Postdoctoral Research Associate with the Department of Materials Science and Engineering, University of Illinois at Urbana–Champaign, Champaign, IL, USA. His research interests include advanced optoelectronic devices/systems, multifunctional nanophotonics, and optical healthcare systems. He is a Senior Member of Optica, member of SPIE and MRS. He is a Senior Editor of IEEE PHOTONICS JOURNAL AND SOFT SCIENCE. He is a Member of the Young Korea Academy of Science and Technology, South Korea.



Yang Chai is currently the Associate Dean of the Faculty of Science, Director of Joint Research Center of Microelectronics of the Hong Kong Polytechnic University, Hong Kong, Vice President of Physical Society of Hong Kong, a member of Hong Kong Young Academy of Sciences, an IEEE Distinguished Lecturer since 2016, the Vice Chair of IEEE EDS region 10, and Chair of IEEE EDS Nanotechnology Committee. During 2017–2019, he was the Chair of IEEE ED/SSC Hong Kong Chapter. His research interest focuses on emerging electronic devices.



Dae-Hyeong Kim received the B.S. and M.S. degrees from the School of Chemical Engineering, Seoul National University, Seoul, South Korea, in 2000 and 2002, respectively, and the Ph.D. degree from the Department of Materials Science and Engineering, University of Illinois at Urbana-Champaign, Champaign, IL, USA, in 2009, respectively. He is currently a Professor with the School of Chemical and Biological Engineering, Seoul National University, an Associate Director of Center for Nanoparticle Research of Institute for Basic Science, and an Associate Editor for *Science Advances*. Since he joined the faculty of the School of Chemical and Biological Engineering, Seoul National University in 2011, he has been focused on soft electronics for biomedical and energy applications.



Xing Sheng received the bachelor's degree from Tsinghua University, Beijing, China, and the Ph.D. degree from the Massachusetts Institute of Technology, Cambridge, MA, USA. He is currently an endowed Associate Professor with the Department of Electronic Engineering, Tsinghua University. He was a Postdoctoral Researcher with the University of Illinois Urbana-Champaign, Champaign, IL, USA. He has authored or coauthored more than 100 papers in peer-reviewed journals like *Nature Photonics*, *Nature Biomedical Engineering*, *Nature Communications*, *Science Advances*, and *Proceedings of the National Academy of Sciences*. His research interests include the exploration of implantable micro- and nano-scale optoelectronic devices for neural signal sensing and modulation. He is a Life Member of SPIE and a Fellow of Optica.



Donghee Son received the Ph.D. degree in chemical and biological engineering from Seoul National University, Seoul, South Korea, in 2015. He is currently an Associate Professor with the Department of Electrical and Computer Engineering, Sungkyunkwan University (SKKU), Seoul. In 2016, he was a Postdoctoral Fellow of Chemical Engineering with the Stanford University, Stanford, CA, USA. In 2017, he was a Senior Research Scientist after moving to Center for Bionics from the Korea Institute of Science and Technology. Since he joined the faculty of the Department of Electrical and Computer Engineering, SKKU, he has focused on self-healing stretchable bioelectronics.



Sejeong Kim received the Ph.D. degree in physics from the Korea Advanced Institute of Science and Technology, Daejeon, South Korea, in 2014. She is currently a Lecturer or Assistant Professor with the University of Melbourne, Melbourne, VIC, Australia. From 2017 to 2020, she was a Research Fellow with the University of Technology Sydney, Ultimo, NSW, Australia. Her research focuses on studying light-matter interaction at the nanoscale particularly using optical cavities. She is an OPTICA Ambassador and the Leader of OPTICA's Nanophotonics Technical Group.