Guest Editorial: Introduction to the JSTQE Issue on Semiconductor Nanocrystal Optoelectronics

WELCOME to the IEEE JOURNAL OF SELECTED TOPICS IN QUANTUM ELECTRONICS (JSTQE) Special Issue on Semiconductor Nanocrystal Optoelectronics. The purpose of this issue is to highlight recent progress and trends in the optoelectronic characteristics and applications of crystalline semiconductor nanoparticles. These nanomaterials, of dimensions below 100 nm and more typically in the 1–10 nm range, are based primarily on II-VI, III-V or Group IV semiconductors and exhibit attractive size-dependent optical and electronic properties. They can be variously functionalized for solution processing and/or heterogeneous integration, facilitating a diverse range of thin films and other structures with customized absorption, emission, and energy transfer properties. Moreover, they can be readily incorporated into a range of photonic crystal and microcavity structures to control light-matter interactions. Optoelectronic applications for these nanocrystals are very broad and include use as fluorescent labels for biosensing and imaging, in new forms of light emitting diode and display technology, in novel lasers including those in mechanically flexible formats, in optical communications, in quantum technology applications, and in solar cells.

The purpose of this issue of JSTQE is to highlight the recent progress and trends in research on semiconductor nanocrystal optoelectronics. The papers published in this issue cover a broad range of photonics areas broadly summarized under the following headings:

- Emerging semiconductor nanocrystal structures, shapes, surface functionalization and materials combinations
- Development of nanocomposites, hybrid integration and artificial heterostructures incorporating semiconductor nanocrystals
- Linear and nonlinear optical properties of semiconductor nanocrystals
- Tailoring excitonic properties in semiconductor nanocrystals for efficient light generation and harvesting
- Self-assembly of semiconductor nanocrystals and their electronic and photonic properties
- Semiconductor nanocrystal light emitting diodes and lasers
- Sensors incorporating semiconductor nanocrystals
- Applications of semiconductor nanocrystals in solar cells and energy harvesting

These key research topics are highlighted by comprehensive overviews of current status and future trends in the field as well as original results and recent developments.

This issue contains 24 papers, including 4 invited and 20 contributed papers authored by both well-established research groups and earlier career scientists from all over the world. The invited papers include overviews of display applications of nanocrystals and comparison of II-VI nanocrystals and organometallic perovskites for laser applications. The contributed papers cover a diverse range of topics in areas including color conversion for visible light communications, use as saturable absorbers, use in photodetectors, in backlights for liquid crystal displays, in white light generation, in waveguide optics, in photonic crystal systems, in mid-infrared applications, and beyond.

We hope you will find this JSTQE Special Issue on Semiconductor Nanocrystal Optoelectronics to be an interesting and useful reference that will impact, stimulate and promote further advances in the field.

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We also wish to thank our many peers and colleagues who responded so enthusiastically to the opportunity provided by this special issue, both in terms of invited and contributed papers. MDD would like to thank the other Guest Editors for their help and Dr. N. Laurand for organizational support.

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Yajie Dong received the B.S. and M.S. degrees in chemistry from Tsinghua University, Beijing, China, in 2000 and 2003, respectively, and the Ph.D. degree from Harvard University, Cambridge, MA, USA, in 2010. He is an Assistant Professor in the NanoScience Technology Center (NSTC), University of Central Florida (UCF), Orlando, FL, USA, with a joint appointment in the College of Optics and Photonics, and the Department of Materials Science and Engineering. Before joining NSTC of UCF in August 2014, he worked as a Senior Scientist at QD Vision Inc and as a Postdoctoral Associate in Massachusetts Institute of Technology. He is broadly interested in material challenges in photonics, optoelectronics, nanoelectronics, and energy technologies, particularly in luminescent quantum dot and perovskite nanomaterials, and high-efficiency energy conversion devices and nanoscale nonvolatile resistive switches for information processing and storage. He is a member of the emissive display subcommittee of SID Technical Program Committee and the technical committee of the Symposium on Displays and Lighting of the IEEE Photonics Conference.

Andrey L. Rogach received the Diploma (Hons.) in chemistry and the Ph.D. degree in physical chemistry from Belarusian State University, Minsk, Belarus, in 1991 and 1995, respectively, studying formation and properties of silver nanoparticles in different media. He is a Chair Professor of photonics materials in the Department of Materials Science and Engineering, and the Founding Director of the Centre for Functional Photonics, City University of Hong Kong, Hong Kong. From 1995 to 2002, he worked as a Postdoctorate (with H. Weller) and then as a Staff Scientist in the Institute of Physical Chemistry, University of Hamburg, Hamburg, Germany. From 2002 to 2009, he held a tenured position of a lead Staff Scientist in the Department of Physics and Centre for NanoScience, University of Munich, Munich, Germany, where he completed his habilitation in experimental physics on light emission and harvesting with semiconductor nanocrystals. In 2009, he joined the City University of Hong Kong, Hong Kong, as a Full Professor and has been advanced to Chair Professor in 2012. His research focuses on synthesis, assembly, and optical spectroscopy of colloidal semiconductor, metal nanocrystals, and their hybrid structures, and their use for energy-related and optoelectronic applications. He has authored more than 300 scientific publications (h-index: 83) in these fields that have been extensively (more than 25 000) cited, which ranked him 51st worldwide among "100 top materials scientists of the past decade" by Thomson Reuters (2011). His distinctions include the DAAD (Germany, 1995) and the Alexander von Humboldt (Germany, 2000) Fellowships, British Telecom (U.K., 1998) and NRC COBASE (USA, 1999) Fellowships, the Walton Award from the Science Foundation Ireland (2005), the Grand Research Excellence Award from the City University of Hong Kong (2011), and the Ikerbasque Fellowship of the Basque Country (Spain, 2012). He holds honorable appointments as an Adjunct Professor at Trinity College Dublin, Dublin, Ireland and the University of Electronic Science and Technology of China, Chengdu, China, an Honorary Professor at Xi'An Jiaotong University, Xian, China, Jilin University, Changchun, China, and Peking University, Beijing, China, and has been a Visiting Professor in Nanyang Technological University, Singapore. He is a Fellow of the Electromagnetic Academy (USA) and serves as an Associate Editor of *ACS Nano*.

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