Guest Editorial
Solid-state Memristive Devices and Systems

NANOTECHNOLOGY has entered its most disruptive phase. After several decades of fundamental investigation on hysteretic memory switching, a truly explosive amount of knowledge has been generated about nanometer scale electronic effects in a very wide range of resistive switching materials. Nanoscale resistive switching elements, also known as memristors, are nowadays regarded as a promising solution for establishing next-generation's memory, due to their infinitesimal dimensions, their capacity to store multiple bits per element and the miniscule energy required to write distinct states. The functional properties of such elements are however associated with rate-dependent electro- or thermo-dynamic changes that are contingent on both the present as well as the past environment, presenting us with a set of rich dynamics that make opportunities in exploiting them as novel computation elements that bring us a step closer towards realsizing bio-inspired systems and applications. The topic of memristive devices covers a wide range of emerging resistive switching devices including oxide-based resistive memories and multilayered metal magnetic memory devices.

The impact of memristors is currently realized through their potential in establishing high spatial- and high storage-density beyond the current CMOS technological roadmap for memory and computation. As an example, present day computing and memory systems burn most of their power in transferring data back and forth between computing and memory blocks. On the contrary memristor technology has the potential of integrating memory and computation locally, dramatically reducing the power-cost in data communication. At the same time the unconventional dynamics of such devices often correlate with counterpart biological systems that are capable of regulating the bio-information flow along with transcribing memory. This approach is currently exploited for establishing unconventional computation formalism that finds application in adaptive systems.

This special issue presents some of the latest developments in this field and covers different aspects of practical memristive devices and systems, including solid-state nanodevices, physical switching mechanisms, circuits and emerging applications. We received a large number of submissions that were contributed by researchers from both academia and industry. This issue, features a total of 16 contributed papers selected through a competitive peer-review process. These cover broadly memristor theory and models, practical solid-state implementations and emerging applications.

We hope that the readers will enjoy these selected papers and that this issue will serve as a stimulus for opening up new research in this emerging field. We would like to express our sincere appreciation to authors of all the papers submitted to this special issue. We warmly thank the reviewers for delivering high-quality reviews in a timely manner that helped us address this challenge and improve the quality of the accepted papers. We would also like to express our gratitude to Prof. Manuel Delgado-Restituto, IEEE JOURNAL ON EMERGING AND SELECTED TOPICS IN CIRCUITS AND SYSTEMS (JETCAS) Editor-in-Chief, and Prof. Yen-Kuang Chen, the Deputy-Editor-in-Chief, and the editorial team of JETCAS for their constant support without which this special issue would not have been possible.

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Dr. Prodromakis is a Member of the INE, the IET, and EPSRC College, and also serves as member of the BioCAS, Nanoelectronics and Gigascale Systems, Neural Systems and Applications, as well as the Sensory Systems Technical Committees of the IEEE Circuits and Systems Society. He is also a member of the IEEE Nanotechnology Council and a member of the Semiconductor Research Corporation (SRC) Emerging Research Devices working group of the ITRS.

Wei Lu (M'14) received the B.S. degree in physics from Tsinghua University, Beijing, China, in 1996, and the Ph.D. degree in physics from Rice University, Houston, TX, USA, in 2003.

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Prof. Lu is a member of the International Technology Roadmap for Semiconductors (ITRS), and member of several IEEE technical committees. He was a recipient of the NSF CAREER Award in 2009, EECS Outstanding Achievement Award in 2012, and the 2014–2015 Rexford E. Hall Innovation Excellence Award.

Jianhua Yang received the B.A. degree in mechanical engineering from Southeast University, Nanjing, China, in 1997, and the Ph.D. degree in material science program from the University of Wisconsin, Madison, WI, USA, in 2007.

He is currently Professor in the Department of Electrical and Computer Engineering Department, University of Massachusetts, Amherst, MA, USA. He spent over eight years at HP Labs before joining the University of Massachusetts in 2015. His current research interests are nanoelectronics and nanoionics, especially for unconventional computing applications, where he authored and co-authored over 100 papers in peer-reviewed academic journals and conferences, and holds 60 granted and over 70 pending U.S. patents. He has guest-edited two journal special issues on nonvolatile memory technologies for *Nanotechnology* and *Applied Physics A*, respectively. He serves as a co-Editor of *Applied Physics A*.

Dr. Yang is a co-Chair of the RRAM session of IEDM 2014. He was the chair of the 8th IEEE Nanotechnology SFBA Council Symposium on "Emerging Non-volatile Memory Technologies" and also the Chair of the 10th symposium on "The Promise and Progress of Nanotech Enabled 2-D Devices and Materials".

Omid Kavehei (M'13) received the Ph.D. degree in electrical and electronic engineering from the University of Adelaide, Adelaide, Australia, with a Certificate of Merit from the Dean. His Ph.D. research has won the 2013 Postgraduate University Alumni Medal, the 2012 University Research Medal, the Gertrude Rohan Memorial Prize for the outstanding research across all disciplines at the University of Adelaide.

In 2011, he joined the Centre for Neural Engineering at the University of Melbourne as a Research Fellow in Microelectronics, where he is working on the first Australian Bionic Eye project, under the High-Acuity Device Development program, to design an intraocular implant (also known as retinal stimulator) that aims to restore the sense of vision to people living with blindness and low vision.

Dr. Kavehei was named as the South Australia's Young Nanotechnology Ambassador by the Australian Nanotechnology Network, in 2011. In 2012 and 2013, he won the Melbourne School of Engineering's Early Career Research Grant, the University of Melbourne's Early Career Research Grant, and an Australian Research Council's Discovery Grant.