Editorial

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Special issue: experimental and computational advances in nano-scale fabrication and characterization

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This issue comprises interesting articles from various and essential topics in nanotechnology, like nano-photonics, nano-probes, nanoparticles and molecular dynamics, along with the recent developments in the relevant fields. The latest experimental and computational methods are also utilized in these investigations. This special issue starts with addressing the implementation of the scanning probe microscope (SPM) in conducting rigorous investigations on the structure and characteristics of terahertz quantum cascade lasers. This work is detailed in the first article "Electrical scanning probe microscopy of electronic and photonic devices: connecting internal mechanisms with external measures" by Ban et al. The authors indicate that the external performance of active photonic devices is governed by internal parameters, such as charge carriers, electric field and electric potential. Therefore, an electrical SPM system is employed to probe the beating heart of the devices in their operation conditions. The two-dimensional profiles of dopants, potential, electric field and free carrier distribution are quantitatively measured at nanometer scales, connecting internal mechanisms with the external performance and disclosing nanoscopic origins responsible for device malfunctions. Then we move to the recent developments in the fabrication and characterization of ideal nano-probes that can be used to optimize the performance of SPM systems and other nano characterization and nanofabrication instruments. This work is detailed in the second article "Characterization and modeling of nanotips fabricated in the field ion microscope" by Ali et al. The authors review the fabrication processes of extremely sharp nano-probes with an apex in the range of 1 nm. They present a new and rigorous method for modeling the nano-probe apex atomic structure, and then a finite element simulation method is used to estimate the overall shape of the nano-probe.

The third article presents recent investigations and advancements of memristors and their fabrication techniques, and entitled "Redox resistive binary oxide memristor devices" by Mohammad et al. The authors review the recent advancements and characteristics of memristive devices, with a special focus on their established resistive switching mechanisms as well as the key challenges associated with their fabrication processes. Magnetic nanoparticles and their application in capturing biomolecules for separation and purification purposes, are discussed in the fourth article "Applications of magnetic nanoparticles in biomedical separation and purification" by Yildiz. The author indicates that magnetic nanoparticles immobilized with affinity ligands could capture targeted biomolecules selectively and sensitively in the presence of other biomolecules and species by the application of an external magnetic field. Thereby resulting in facile enrichment and purification of targeted biomolecules and efficiently in a relatively short period of time.

The investigations of water molecular dynamics, relaxation, diffusion and flow in carbon nanotubes (CNTs) using nuclear magnetic resonance (NMR) system are reviewed in the fifth article "Water inside carbon nanotubes: structure and dynamics" by Hassan et al. In this article the authors present an interesting review of recent experimental and theoretical results using NMR and molecular dynamics (MD) simulations on confined water inside CNTs. They show that several studies and measurements at different temperatures confirmed the existence of water in liquid phase well below 273 K (reaching 200 K). The freezing point of water confined in CNTs is found to be inversely proportional to the size of the confinement. An enhancement of the self-diffusion coefficient is also reported using MD simulation of water inside single wall CNTs.

A new finite element simulation method for characterizing the electronic structures and electrical characteristics of nano metal-semiconductor contacts is

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highlighted in the sixth article "Finite element simulation and analysis of nano metal-semiconductor contacts" by Eledlebi et al. The simulation model is built with a geometry of nano metal particle embedded in the surface of a semiconductor substrate. Then a finite element simulation software is used to find the maximum electric field at the interface and calculate I-V characteristic curves. The seventh article "Theoretical study with dipole moment calculation of new electronic states of the BF molecule" by Al Shawa et al. studies the electronic structures of boron monofluoride (BF) molecule, where 12 electronic states of the BF molecule are reported here for the first time.

Finally, this issue has managed to present the latest developments in crucial and interesting fields of nanotechnology and would help establish an adequate foundation for further improvements in these fields. In this regard, I would like to acknowledge all authors and reviewers for their great contributions and efforts that helped to bring up such a comprehensive issue. I also appreciate the assistance from the editorial office of *Nanotechnology Reviews* for making this work possible.