Journal of Nanophotonics

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Sergey A. Maksimenko
Gregory Y. Slepyan

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**Sergey A. Maksimenko and Gregory Y. Slepyan**
Belarus State University, Institute of Nuclear Problems, Bobruiskaya Str. 11,
220050 Minsk, Belarus
sergey.maksimenko@gmail.com, gregory_slepyan@yahoo.com

The history of carbon nanotubes (CNTs) really starts from a 1991 paper of Iijima [1], though some works had been published earlier [2]. During the last two decades, owing to their unusual and fascinating properties [3], CNTs have been the subjects of intensive research in the areas of both fundamental science and nanotechnology. The number of publications on CNTs continues to increase unabated. Nevertheless, understanding of their fundamental physics is still far from complete, while the potential of CNTs is so huge and their possible applications so diverse that any attempt to give a more or less complete picture within a reasonable space is doomed to failure. That is why many reviews and special sections/issues devoted to different aspects of the CNT science and technology are continually being published in scientific periodicals. The present Special Section lies squarely in that series.

From a variety of problems, we choose for this Special Section the application of CNTs for the transmission, control and interface management of electric and electromagnetic signals and related topics. The emergence of nano-sized structures as key building blocks of nanoelectronic and nanophotonic devices has extended to the nanoscale such classical problems of the circuit theory as the performance of circuit components—e.g., interconnects, transmission lines, and antennas—their electromagnetic compatibility, noise control, and so on. Moreover, new frequency ranges—from the terahertz to the optical—are involved in the operational diapason, expanding thereby the repertoire of circuit components. Quantum mechanics comes into play to a full extent determining, for example, the critical role of the tunneling through CNT contacts. Obviously, such an extension requires the development of new functional components and new physical models of their operation as well as the radical modification of the basic principles of circuit theory which conventionally relies on macroscopic electrodynamics.

In this Special Section, the reader will find nine relevant papers. A comprehensive exposition of the hydrodynamic model of the signal propagation in CNTs and a detailed discussion of the CNT application as VLSI interconnects are presented by Forestiere *et al.* and Srivastava *et al.*, respectively. These two papers, as well as the paper Nemilentsau *et al.* devoted to the near-field response of CNTs, may serve also as an advanced introduction into applied electrodynamics of CNTs. The paper of D'yachkov and Makaev presents the linear augmented cylindrical wave method as an advanced tool for the simulation of the electronic structure of CNTs (including chemically modified CNTs) beyond the tight-binding approximation. The idea of a nanorelay based on cantilevered nanotubes filled with magnetic endofullerenes, presented by Poklonskii *et al.*, demonstrates the diversity of the potential of CNT-based systems and contributes to the wide spectrum of works on the fundamental components for nanoelectronic circuits. As applied to a CNT/graphene interface exposed to an electromagnetic field, the tunneling problem is investigated by Belonenko *et al.* beyond the standard approximations of the Kubo theory, demonstrating the tunneling effect for electronic control using CNTs. Batrakov *et al.* discuss several proposals on the terahertz optoelectronics application of CNTs, such as terahertz emitters, frequency multipliers, and detectors. Among other applications, the interaction of a CNT with an electromagnetic field can serve as a characterization mechanism. An advanced Raman spectroscopy method for probing CNT chirality in samples containing CNTs with diverse chiral indexes is presented


Received 10 Apr 2010; accepted 12 Apr 2010; published 10 Jul 2010 [CCC: 19342608/2010/$25.00]

by Telg *et al.*, while the absorption and emission spectra of CNT arrays exposed to ultrasoft X-rays are presented and discussed by Okotrub *et al.*

We hope that the CNT-related problems and physicals effects discussed in these nine papers warrants their collective publication as a Special Section and will arouse interest in the readers of the Journal of Nanophotonics. In conclusion, we thank all the authors for their contribution to this Special Section and the reviewers for their splendid cooperation.

## References


[1] S. Iijima, "Helical microtubules of graphite carbon," *Nature* **354**, 56–58 (1991) [doi:10.1038/354056a0].

[2] M. Monthioux and V. L. Kuznetsov, "Who should be given the credit for the discovery of carbon nanotubes?" *Carbon* **44**, 1621–1623 (2006) [doi:10.1016/j.carbon.2006.03.019].

[3] S. Reich, C. Thomsen, and J. Maultzsch, *Carbon Nanotubes: Basic Concepts and Physical Properties*, Wiley-VCH, Weinheim, Germany (2004).