

Preface

Since Iijima's discovery of carbon nanotubes (CNTs) in 1991, these unique nanoobjects have been the focus of enormous research in physics, chemistry, and material science.

It is hard to overestimate the contribution of CNT research for the past two decades in understanding the fundamental science of carbon nanostructures and their applications ranging from renewable energy to nanobiology and nanomedicine.

One of the exciting fields of CNT science is a light interaction with carbon nanotubes revealing principally new features in light absorption, luminescence, and photoconductivity associated with their quasi-one dimensional nature such as nanotube chirality, diameter, aspect ratio, etc. Photophysics of CNTs is rich and full of remarkable phenomena existing only in CNT structures, which do not have their bulk analogs distinct, for example, from quantum dots. Because of great interest in CNT optical spectroscopy and optoelectronics, a large number of books, book chapters, and reviews appeared in recent years considering not only the fundamental principles of CNT optics, but also various applications in the field of photovoltaics, IR detectors and imaging, transparent conductive coating, nonlinear optics, photo-mechanical actuators, LEDs, and optochemical/bio sensing.

If photophysical properties of pristine CNTs are studied relatively thoughtfully, a much less explored area is light interaction with nanotubes interfaced with other materials (e.g., organic, inorganic, bulk or nanoscale structures forming physical or chemical bonding with nanotubes). An addition of another compound to CNT and creation of CNT-based nanohybrid open new opportunities for researchers; first of all, because of much versatility of CNT composites and existence of interface between CNT and its counterpart, which is not possible for pristine nanotubes. Interfacial region in such hybrids plays a critical role being responsible for various photoinduced mechanisms such as charge transfer and recombination, energy transfer, photo-mechanical elastic response, thermal effect, spectral changes in Raman, absorption, and photoluminescence. This aspect, photophysics of carbon nanotubes interfaced with other materials, is the main focus of the presented monograph covering three areas: (i) light harvesting and energy conversion, photoinduced charge transfer, polarization and charge separation in CNT-based nanohybrids (I. A. Levitsky); (ii) the use of CNT composite for photo-mechanical actuators (W. B. Euler); and (iii) CNT/DNA hybrid optical spectroscopy, structure,

and MD simulations and related applications in biosensing and biomedicine (V. A. Karachevtsev).

The first chapter primarily describes the recent advances and new achievements in fundamental and applied sciences shedding light on the nature of photoconversion mechanisms in CNT nanohybrids with a short background on previous studies in the field of photoinduced charge transfer, hybrid photovoltaics, photodetecting devices, and bolometers.

The second chapter is dedicated to CNTs and mostly CNT composites employed in photo-mechanical actuators with large photo-elastic response associated with charge accumulation and interface polarization. This is a relatively new discipline, existing for less than a decade; however, with impressive promises for future applications in light to mechanical energy conversion.

The third chapter presents a review of recent works in the field of photophysics of CNT/DNA hybrids which continue to be an active research area. In spite of essential differences between DNA and nanotube structures, properties of these two nanoobjects supplement each other forming a hybrid with specific physical and optical features. Here, the major focus is done on absorption and luminescence spectroscopy with conjunction of molecular dynamics simulation of CNT/DNA hybrids as well as possible applications in biosensing and drug delivery.

We hope that this monograph will be of interest for physicists, chemists, and material scientists working on carbon nanotube composites in fundamental and applied fields.

Photophysics of Carbon Nanotubes Interfaced with
Organic and Inorganic Materials

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2012, VIII, 164 p., Hardcover

ISBN: 978-1-4471-4825-8