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PREFACE

Ultrafast and nonlinear optics in carbon nanomaterials

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Carbon-based nanomaterials—single-wall carbon nanotubes (SWCNTs) and graphene, in particular—have emerged in the last decade as novel low-dimensional systems with extraordinary properties. Because they are direct-bandgap systems, SWCNTs are one of the leading candidates to unify electronic and optical functions in nanoscale circuitry; their diameter-dependent bandgaps can be utilized for multi-wavelength devices. Graphene's ultrahigh carrier mobilities are promising for high-frequency electronic devices, while, at the same time, it is predicted to have ideal properties for terahertz generation and detection due to its unique zero-gap, zero-mass band structure. There have been a large number of basic optical studies on these materials, but most of them were performed in the weak-excitation, quasi-equilibrium regime. In order to probe and assess their performance characteristics as optoelectronic materials under device-operating conditions, it is crucial to strongly drive them and examine their optical properties in highly non-equilibrium situations and with ultrashot time resolution.

In this section, the reader will find the latest results in this rapidly growing field of research. We have assembled contributions from some of the leading experts in ultrafast and nonlinear optical spectroscopy of carbon-based nanomaterials. Specific topics featured include: thermalization, cooling, and recombination dynamics of photo-generated carriers; stimulated emission, gain, and amplification; ultrafast photoluminescence; coherent phonon dynamics; exciton–phonon and exciton–plasmon interactions; exciton–exciton annihilation and Auger processes; spontaneous and stimulated emission of terahertz radiation; four-wave mixing and harmonic generation; ultrafast photocurrents; the AC Stark and Franz–Keldysh effects; and non-perturbative light–mater coupling.

We would like to express our sincere thanks to those who contributed their latest results to this special section, and the *Journal of Physics: Condensed Matter* staff for their help, patience and professionalism. Since this is a fast-moving field, there is absolutely no way of presenting definitive answers to all open questions, but we hope that this special section will provide an overview of the current state of knowledge regarding this topic. Furthermore, we hope that the exciting science and technology described in this section will attract and inspire other researchers and students working in related fields to enter into the study of ultrafast and nonlinear optical phenomena in carbon-based nanostructures.

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