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Editorial

Advances in Novel Optical Materials and Devices

Michael R. Gleeson,¹ Yasuo Tomita,² Sergi Gallego,³ and Robert McLeod⁴

¹ *Optoelectronic and Communications, Research Centre, University College Dublin, Dublin 4, Ireland*

² *Department of Engineering Science, University of Electro-Communications, 1-5-1 Chofugaoka, Chofu, Tokyo 182-8585, Japan*

³ *University Institute of Physics Applied to Sciences and Technologies, University of Alicante, Ap. De Correos 99, 03080 Alicante, Spain*

⁴ *Department of Electrical, Computer and Energy Engineering, University of Colorado at Boulder, ECEE 1B47, Boulder, CO, UCB 425, USA*

Correspondence should be addressed to Michael R. Gleeson; michael.gleeson@ucd.ie

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This special issue highlights the continuous growth and advancement in the field of optical materials and optical devices. Extensive research carried out in these areas has led to the development of novel applications and uses in a range of areas, including biomedical devices, imaging, optical communication networks, optical storage media, and photovoltaics. In order to maintain the successful growth and diversity in these areas, a better understanding of optical materials and their behaviour is required. Achieving this will then enable improvements in material performance and material functionality and potentially yield more innovative devices and applications.

The research contributions presented here illustrate recent significant efforts undertaken throughout the field of optical materials and optical devices. A variety of works are provided, encompassing many research areas within the field. The following is a brief introduction to the scope of the research which is offered with this special issue.

The paper provided by Z. Lu et al. extends the concept of a single frequency band, single high-refractive-index metamaterial and then applies it to the simulation and design of dual frequency band, dual high-refractive-index metamaterial in the THz regime. The resulting metamaterial designed with gold structures embedded with polyimide film effectively exhibits high refractive index at two frequency bands. These results indicate that through modification of the geometry and design of these structures, a higher refractive index can be achieved at the second resonant frequency, thus leading

to a single structure multifrequency, multiple high-refractive-index metamaterial, which could be used in a variety of practical applications.

J. Fujimoto et al. report on their continued development of their first generation extreme-ultraviolet (EUV) light source for high volume manufacturing (HVM) “GL200E.” They review some of their latest data and describe their system and the various original concepts that they have proposed, including (1) highly efficient Sn plasma generation, driven by pulsed CO₂ laser (2) double pulse irradiation scheme for Sn plasma generation (3) Sn debris mitigation by a magnetic field and small Sn droplet size and (4) hybrid CO₂ laser system using a combination of a short pulse oscillator and commercial cw-CO₂ amplifiers.

The paper by B. B. Yousif and A. S. Samra provides a detailed investigation of the optical properties of plasmonic nanoantennas using a finite integration technique, with particular emphasis on near-field resonances and far-field radiation properties. They also report on the role that geometrical parameters such as antenna length and gap dimension have on the field enhancement and spectral response. Field enhancement can lead to resolution improvements in applications such as microscopy and optical lithography, therefore increasing optical data storage capacity and offering potential improvements in sample detection and medical imaging.

X. Liu and Y. Tomita developed a closed-aperture Z-scan theory capable of characterising nonlinear optical materials such as novel QD-polymer nanocomposite materials.

They show that the observed large nonlinear refraction and induced transparency as well as the capability of holographic nanoparticle assembling make QD-polymer nanocomposite materials promising for nonlinear photonics applications (e.g., optical switching, limiting, and signal processing) by use of holographic Bragg grating structures that provide the electromagnetic nonlinear feedback mechanism.

A literature review provided by D. L. Griscom discusses the nature of radiation-induced point defects in silica-based optics. He discusses and argues the role that self-trapped holes play in transient radiation-induced red/near IR optical absorption in these silica-based photonics and also provides methods which can be utilised to permanently minimize the numbers of environmentally or operationally created self-trapped holes. In particular, he emphasises the importance of utilising fractal kinetics as a means of extrapolating the results of dose-rate-dependence studies backward into time regimes and forward into supra-high-dose-rate regimes.

In a very interesting piece of work, K. Kasala and K. Saravanamuttu explore the generation of self-trapped incoherent hybrid beams in a photocrosslinkable organosiloxane. The temporal and spatial variations in the refractive index of the material caused the encapsulation of the incoherent light. Subsequently, this encapsulation gradually increases the light confinement giving these filaments similar characteristics to optical fibres, protecting each filament from interactions with other nearby self-trapped filaments. This work offers new possibilities for the manipulation and confinement of self-trapped beams.

J. Guo et al. presents a comprehensive review of works in the literature on the optimisation of photopolymer materials for holographic applications. This work highlights the major advancements made in the area and indicates a number of outstanding developmental issues. It is proposed that to overcome these issues, an accurate theoretical representation of the various photokinetic behaviour which occur in these photopolymers is required. This would allow potential trends to take advantage of improving photopolymer performance.

S. Gallego et al. present work on the development of a method based on a zero spatial frequency recording and interferometric techniques to determine quantitative values of shrinkage, polymerization rate, polymer refractive index, and the relation between intensity and polymerization. They also present some simple models used to extract these various parameters from a number of photopolymer materials. This work offers techniques to characterise the viability of photopolymers for diffractive and holographic applications.

Y. Qi et al. present recent advances in the nonlocal photopolymerisation driven diffusion (NPDD) model, including a generic representation for photosensitiser kinetics during and after illumination. They analyse a number of different photosensitisers and indicate trends from their resulting theory which enable material optimisation for the application required.

The scope of the works presented in this special issue offers a real insight into the progress made across a wide range of areas within the field of optical materials and optical devices. It is clear that from this continued pursuit of

knowledge many exciting new applications and devices will be on the horizon.

Acknowledgment

On behalf of the guest editors, we would like to thank all those who have contributed to the production of this very interesting and informative special issue.

*Michael R. Gleeson
Yasuo Tomita
Sergi Gallego
Robert McLeod*