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Bio-inspired and bio-integrated photonic materials and devices: feature issue introduction

XING SHENG,[1,*] LI GAO,[2] YOUNG MIN SONG,[3] HU TAO,[4] AND SEOK-HYUN YUN[5]

[1]Tsinghua University, China
[2]Nanjing University of Posts and Telecommunications, China
[3]Gwangju Institute of Science and Technology, South Korea
[4]Shanghai Institute of Microsystem and Information Technology, CAS, China
[5]Harvard Medical School and Massachusetts General Hospital, MA 02114, USA
[*]xingsheng@tsinghua.edu.cn

Abstract: Recent progresses in materials design, synthesis and characterization, together with emerging methods for device fabrication and system assembly, have lead to high performance photonic materials, devices, and systems in bio-adaptable and/or bio-compatible formats, thereby enabling advanced bio-related photonic platforms. In this feature issue, 10 papers represent the most recent progress in various aspects of bio-inspired and bio-integrated materials from silicon, perovskites and organics, devices like photodetectors, plasmonic sensors and light emitters, and their diverse applications in areas including sensing, prosthesis and therapy. Although this feature issue only provides a glimpse of the vast field of bio-related photonics, we hope that it can offer a guideline for researchers involved in this emerging area.

Recent progresses in materials development, device engineering and mechanical design have given birth to photonic systems with unconventional functionalities such as mechanical flexibility, biocompatibility and resorbability, thereby enabling novel opportunities for bio-related optoelectronic platforms [1]. Such efforts have lead to advanced bioinspired and biointegrated materials and devices that not only provide novel insights on light-matter interactions at bio-interfaces, but also explore versatile opportunities for sensing, diagnostics and therapeutics both *in vitro* and *in vivo*.

Innovative material design and device architectures are being actively pursued to improve the performance of optical and electronic sensors and detectors, by emulating morphologies and/or functions of biological systems. In this feature issue, Prajzler *et al.* investigated the optical properties of an important biological substance, deoxyribonucleic acid (DNA) complexes, deposited on elastomer substrates [2]. Gao *et al.* employed deoxyribonucleic acid (DNA) and guanine as functional interfacial layers to enhance the photocurrent of perovskite based photodetectors [3]. Additionally, Yang *et al.* implemented hair like gold nanowires for high performance strain sensors [4]. Moreover, Li *et al.* developed neural inspired computational models to design and optimize plasmonic sensors [5].

Innovative processing and manufacturing, associated with the multifunctional integration of organic/inorganic components, have enabled a wide spectrum of high performance electronic and photonic materials, devices, and systems in soft, flexible, stretchable and/or biocompatible formats. Li *et al.* [6] and Chen *et al.* [7] respectively reviewed recent developments of flexible and stretchable inorganic and organic based optoelectronic materials, devices and systems, and highlighted their versatile biomedical applications. In addition, Xu *et al.* presented silicon based light emitters and their integration with micro-fluidic sensors [8].

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In particular, micro- and nanoscale optoelectronic components that are engineered as implantable devices have attracted tremendous interests in biomedicine. Jang *et al.* overviewed the recent progress and challenges of retinal prosthesis devices for vision restoration [9]. Nazempour *et al.* analytically evaluated the performance of implantable optical sensors for fluorescence imaging in the deep animal brain [10]. Fernandes and Kolios showed the potential of using perfluorocarbon bubbles as photoacoustic signal amplifiers for cancer theranostics [11].

To summarize, this feature issue provides a forum to discuss various approaches to realize advanced high performance bio-inspired and bio-integrated photonics. Such advanced materials, devices and systems offer not only fundamental impacts on light-matter interactions at bio-interface, but also new opportunities for sensing, diagnostics, and therapeutics. Certainly, we hope that this feature issue will inspire new research directions and novel concepts in this emerging field.

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Disclosures

The authors declare that they have no competing interests.

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