

Preface

55th Anniversary Issue of *Photochemistry and Photobiology*[†]

This special issue commemorates the 55th Anniversary of *Photochemistry and Photobiology*. The issue consists of papers from contributors who have had significant ties to the Journal and the American Society for Photobiology (ASP), including former and current editors of the Journal, council members of the ASP, as well as active authors.

This commemorative issue consists of 46 papers by these individuals that are located in regions throughout the world, including Argentina, Australia, Brazil, Canada, Chile, China, Czech Republic, France, Germany, Italy, Japan, Norway, Poland, Spain, South Africa, Russia and the United States. Some of the papers explore the photochemistry and photophysics of new sensitizers, fluorophores, natural products, biomolecules and photo-synthetic antennas. Other papers describe the photobiology of DNA, RNA, proteins, visual pigments and lipids. Still, other papers explore photobiomodulation, photolyases and photodynamic therapy (PDT), where synergy (*i.e.*, combination therapy) is a common theme. The formation of reactive oxygen species is reported in a number of these papers, such as aqueous media, liposomes and *in vitro* and *in vivo* samples.

The focus on sensitizers and fluorophores was one facet in this symposium. The contributors include McFarland, Sun *et al.* who describe synthesis, characterization and photobiological activities of a new series of Ru(II) oligothiophene sensitizers. The study of organic photochemistry includes chiral inductions in photodimerizations as focus of research by Tung *et al.* and steric influences in the photoenolization of diortho-substituted acetophenones by Gudmundsdottir, Bohne *et al.* The synthesis and electronic coupling within Pd-phthalocyanine-carotenoid dyads as artificial photosynthetic antennas were the focus of work by Ho, Gust, Moore, Moore *et al.*, including the careful tuning of the triplet-triplet energy transfer, which was also the subject of a highlight piece by Polívka. A detailed photophysical study of the interaction of photoexcited pterin with four of the most reactive amino acids via dynamic and static processes was performed by Thomas *et al.* Fluorogenic BODIPY- α -tocopherol analogues have been shown by Cosa *et al.* to be relevant probes for reactive oxygen species. Armitage *et al.* described the fine-tuning of the excitation wavelength for thiophene triarylmethane dyes, including fluorescence intensity increases when bound to a protein. Research was also examined by fast spectroscopic techniques to uncover answers to photophysical details including work by Kohler and Crespo-Hernández. Rochford, Hatamimoslehabadi *et al.* have probed photoacoustic agents and found that π -bond extended curcumin dyes, in particular naphthyl and thienyl curcuminoids have promise in photoacoustic imaging applications.

Another set of articles in this symposium discusses singlet oxygen ($^1\text{O}_2$), which is the main reactive oxygen species generated by the type II photosensitization mechanism. In that respect, Quina *et al.* reported that pyranoanthocyanins similar to those formed during the aging of red wines have fairly long triplet lifetimes and are thus generators of $^1\text{O}_2$ in acetonitrile, although their capacity to generate $^1\text{O}_2$ is dampened in aqueous and acid media. Thomas, McFarland, Greer *et al.* provided insight with a U-shaped design for sensitizer drug photorelease using $^1\text{O}_2$ as the cleaving agent. Other fair sources of $^1\text{O}_2$ consist of functionalized fullerenes and surface TiO_2 nanoparticles that were shown by Sarna *et al.* to trigger upon excitation lipid peroxidation. Type II photosensitized reactions of cholesterol, a relevant PDT target, that give rise to three isomeric hydroperoxides are critically surveyed by Girotti *et al.* in an extensive review article that is highlighted by Chiemezie and Greer. The relevance of using uric acid as a probe of $^1\text{O}_2$ that may vary according to experimental conditions has been revisited by Ogilby *et al.*

Photobiochemistry of isolated and cellular DNA was also a significant focus in this symposium. Taylor *et al.* and Shafirovich, Geacintov *et al.* reported the reactivity of G-quadruplex model structures of human telomere sequences to UVB-induced crosslink formation and photosensitized one-electron oxidation, respectively. The main one-electron oxidation reactions of isolated and cellular DNA triggered by biphotonic ionization of pyrimidine and purine bases were reviewed by Cadet *et al.* It has been demonstrated by Ahmad *et al.* that nicotinamide exerts a protective role against DNA damage induced by UVB and UVA irradiation of melanocytes. Other important cellular targets investigated include lipids and proteins. In contrast to recent claims, it was found by Douki *et al.* that 6-formylindolo[3,2-*b*]carbazole (FICZ) is generated as a minor photoproduct of tryptophan by either UVB radiation or simulated sunlight.

DNA repair is essential for maintaining genome integrity. Nishigori *et al.* have provided a survey of the characteristics of Japanese xeroderma pigmentosum patients who suffer from deficiencies in the DNA repair of bulky bipyrimidine photoproducts. Albaraccin *et al.* have isolated photoactive proteins as putative photolyases/cryptochromes that confer high UV-resistance to bacteria from Andean lakes.

Various biological responses of bacteria and human cells to UV components of solar radiation have been the focus of articles. Beardall and Islam reported a dependence of UV-sensitivity of cyanobacteria on temperature according to the strains. Menck *et al.* demonstrated that the ATR/chk1 pathway is activated by oxidative reactions triggered by UVA radiation in xeroderma pigmentosum variant cells. Wu and Zhao have shown that post-UVB-induced release of nitric oxide from endothelial cells promotes the transformation of keratinocytes. Nanomolar phototoxicity of 1,9-

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dimethyl methylene blue on human cells through specific photosensitized damage to mitochondrial DNA and lysosomes was demonstrated by Baptista *et al.*; it was found to be a p53 independent response. It was reported by He *et al.* that eukaryotic regulation of RNA methylation plays a major role in the UV-induced DNA damage response and circadian clock machinery. The main regulated signaling processes triggered by melanopsin, a G-protein nonvisual photopigment, are surveyed in the review article by Sarna and Stachurska. Gaillard *et al.* focused on retinal pigment epithelial (RPE) melanin including peroxide-treated synthetic melanin to help deduce the degradation products involved in RPE cell damage by UVB light.

Assessment of human solar exposure and associated health risk were the subjects of three studies on South African and Australian populations. The article by Ramotsehoa, Wright *et al.* focus on sun exposure and protection behaviors of outdoor workers. Low solar exposure and vitamin D deficiency were identified by Lucas *et al.* as risk factors for inflammatory bowel disease. The main target in a sun protected intervention study performed by Wright *et al.* was the immune response to booster measles vaccination in a child population.

The symposium papers also include low-level laser therapy (LLLT) also called photobiomodulation (PBM) as a clinical tool. In their thorough survey, Hamblin *et al.* reviewed the response of a wide variety of organisms ranging from bacteria and fungal cells to vertebrate animals with several light sources including infrared and near-infrared lasers and light-emitting diodes. Further considerations of LLLT and PBM on cellular pathways were provided by Amaroli *et al.* in a companion highlight article.

Chemiluminescence in biological systems is also under intense study. Busch *et al.* describe luminol chemiluminescence as an innovative way to detect myeloid cells following PDT, in which the process is attributed to neutrophils due to Ly6G expression. The bioluminescence variation due to site-directed mutagenesis in photoproteins was also examined by Vysotski *et al.* in response to calcium ion.

PDT has been assessed in combination with other tumor eradication techniques and is a recurring theme in the symposium. Cengel *et al.* used a 3D mesothelioma cell culture to show that PDT combined with erlotinib (a drug tyrosine kinase inhibitor acting on the epithelial growth factor receptor (EGFR)) can lead to an enhanced effect. Spring and Kessel produced a highlight article describing the virtues of PDT under the synergy of EGFR suppression for countering tumor recurrence. Simone, Cengel *et al.* reported on the combined use of PDT and proton therapy (PT) for mesothelioma patients. Here, a prolonged survival in patients was observed suggesting possible spatial or systemic cooperativity and immune effects.

Further PDT protocols were also used to exploit synergy by Rizvi, Kessel, Hasan *et al.* who describe sensitizer type and liposome formulation for selective bifurcated delivery of a visudyne conventional liposome via passive diffusion and a lipid anchored-benzoporphyrin derivative liposome via endolysosomal uptake. Here, an increased PDT effect was due to the dual photodestruction of lysosomes and mitochondria (endoplasmic reticulum) in a 3D model for ovarian cancer. The translational potential of the 3D model is also described. In another paper, Hasan *et al.* examine photonanomedicines (PNMs) to deduce photophysical and photochemical factors in the effective eradication of ovarian cancer cells. Predictions of PDT efficacy included these factors along with nanolipid formulations of BPD for the discrete targeting of lysosomes and mitochondria/ER. Kessel reports on apoptosis, paraptosis and autophagy in pathways associated with PDT. Here, a combination of lysosomal and mitochondrial targets is found to enhance PDT efficacy, including “paraptosis” with formation of misfolded ER proteins.

Other synergistic facets of PDT are also under study. Theodosiou *et al.* described synergism in PDT and cytotoxic copper ion effects of cercosporin in glioblastoma multiforme and breast adenocarcinoma human cell lines. Here, the localization of cercosporin was in both mitochondria and the endoplasmic reticulum. Hasan *et al.* describe the use of ultrasound in measuring the volume of murine pancreatic tumors, which compares favorably to conventional measurements by calipers or by weighing. Here, the ultrasound tumor volume was shown to be a rapid technique as judged with PDT alone and PDT in combination with irinotecan.

This special issue not only brings together timely subjects, it also celebrates the 55th Anniversary of *Photochemistry and Photobiology*. Progress is highlighted in photochemistry, photobiology and photophysics as well as photosynthesis and photomedicine. We felt there was considerable enthusiasm by the contributors to this celebratory issue of the Journal. There are many facets to the fields covered by the Journal that remain to be explored. Therefore, we look forward to submissions of manuscripts that continue toward an ever better understanding in the photosciences.

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