

# ***Biophotonics and Immune Responses X***

**Wei R. Chen**  
*Editor*

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## **Biophotonics and Immune Responses: The 10-Year Journey**

The United Nations has named 2015 as the International Year of Light. It is a fitting designation, since light has played such an important role in the advancement of science and technology, epitomized by the 2014 Nobel Prizes in Physics (*"for the invention of efficient blue light-emitting diodes which has enabled bright and energy-saving white light sources"*) and in Chemistry (*"for the development of super-resolved fluorescence microscopy"*).

Many advances in both optics and photonics are directly utilized in biomedical applications, both in diagnostics and in therapeutics for various diseases. Continued growth in biophotonics-related research and applications, as demonstrated by increasing numbers of presentations in these fields at SPIE conferences, provides unequivocal evidence that we are truly riding a 'light' wave.

It has long been known that many diseases trace their roots to unbalanced immune systems, such as a controlled upregulated immune system for autoimmune disease and a severely downregulated immune system for HIV. However, for the past several decades, understanding and manipulating immune systems has been a slow, often confusing, process, due to the complex nature of the immune system and the lack of appropriate biological and physical techniques.

Recent advances in science and technology – in no small part in opto-electronics – have provided the tools required by scientists, engineers, physicians, and other professionals in immunological studies. In this past decade, we have acquired a wealth of valuable knowledge concerning the functions of our own immunological systems, and have since developed many significant immunology-based approaches to disease diagnosis and treatment.

Progress in the field of cancer has been particularly significant; so much so that in a December 2013 editorial, Marcia McNutt, Editor-in-Chief of the journal *Science*, declared, about cancer immunotherapy, *"Constructed over decades, it has begun to demonstrate such promising results in cancer patients that we have selected it as the Breakthrough of the Year for 2013."* Likewise, the journal *Nature Review Cancer* devoted almost an entire issue in April 2012 to cancer immunotherapy.

Granted, there remains a long way to go before we truly understand the inner workings of the immune system and, eventually, properly regulate the system. However, current advances in immunology give us more than enough to be

encouraged and to double our efforts to fight against all illnesses and reduce suffering, using the most powerful tool at our disposal: the immune system.

In light of these immense, exciting achievements in biophotonics and immunology and in the International Year of the Light, we welcome and celebrate the tenth anniversary of our conference, *Biophotonics and Immune Responses* (BPIR).

BPIR in Photonics West was not a coincidence. This was due to the efforts of many dedicated researchers and supporters. In 1998, just as researchers began to pay close attention to immunological responses, induced by photophysical and photobiological laser-tissue interactions, a small group of scientists ventured further. With the support and encouragement of Steven Jacques, the Chair of the Conference *Laser-Tissue Interaction*, two unique sessions were presented in *Laser-Tissue Interaction IX*: "Immunological Mechanism during PDT I" and "Immunological Mechanism during PDT II and Photochemical Mechanisms."

The first five biophotonics-immunological talks presented are given below:

### **Session 1**

#### **Immunologic Mechanisms During PDT 1**

*Cancer treatment by photodynamic therapy combined with NK-cell-line-based adoptive immunotherapy (Invited Paper)*, M. Korbelik, J. Sun, British Columbia Cancer Agency (Canada)

*Photodynamic therapy with photoactivated aluminum disulfonated phthalocyanine and cellular immune response (Invited Paper)*, G.L. Canti, et al, Ctr. Di Elettronica Quantistica e Strumentazione Elettronica (Italy)

*Photodynamic therapy affects the expression of IL-6 and IL-10 in vivo (Invited Paper)*, S. O. Gollnick, D. A. Musser, B. W. Henderson, Roswell Park Cancer Institute (United States)

*Antitumor immune responses induced by photodynamic immunotherapy in rats*, W. R. Chen et al, Oklahoma School of Science and Mathematics and Univ. of Oklahoma (United States)

### **Session 2**

#### **Immunologic Mechanisms During PDT II and Photochemical Mechanisms**

*Morphological studies of metastatic mammary rat tumors after laser immunotherapy treatment*, R. E. Nordquist, et al, Univ. of Oklahoma (United States)

The presenters in the first sessions included Gianfranco Canti, a pioneer in PDT-induced immune responses in cancer research from Italy, and Mladen Korbelik and Sandra Gollnick, two leading immunologists active in PDT from Canada and the United States, respectively. Also included were Wei R. Chen and Robert Nordquist, two researchers from Oklahoma, who had been working on a new approach combining photothermal and immunological interactions for the treatment of metastatic cancers.

These special sessions on biophotonics and immune responses continued to flourish under the umbra of the *Laser-Tissue Interaction* conference for several years. They continued to attract the interest of individuals in different areas related to immune activities, such as disease detection, therapeutic approaches, and immunological mechanisms at the molecular and cellular levels. The decision was made, therefore, to start a new conference. During a meeting of the regular participants in January 2015, several names were proposed for the new conference. Following a brief discussion, *Biophotonics and Immune Responses*, proposed by Michael Hamblin, was selected.

On behalf of this group, Wei R. Chen proposed the new conference to the SPIE executive committee. As stated in the proposal, the purpose of the conference is as follows.

*"This proposed conference will be a bridge between technology development and clinical applications, in the induction and detection of immune responses. It will provide a forum for people of many disciplines, including academia, industry, and health professions.*

*"This conference will attract researchers and clinicians who are searching for an effective immunological modality for different diseases, ranging from autoimmune diseases to cancer, using optical methods. Many researchers and physicians who do not usually come to SPIE meetings will find a home in this conference. Therefore, this conference will not only have strong support from the current core group in this area but will also attract many new participants.*

*"This new conference will also include the detection of immune activities, using molecular and cellular imaging, and other imaging modalities. This has been a budding area of research and needs a forum to work hand-in-hand with researchers and clinicians in photo-immune stimulations."*

The new conference proposal easily sailed through all approving committees. The Biophotonics and Immune Responses conference became reality in 2006, as one of the Photonics West conferences in San Jose, California.

The original topics covered in the 2006 conference included:

- Opto-immune therapies
- Novel technologies in monitoring immune activities
- Novel combination therapy in cancer treatment
- New approaches in inducing immune responses
- Low intensity laser and systemic therapeutic effect
- Sensing and sensors for immune activities
- Molecular imaging for immune responses
- *In vitro* cellular and biomolecular responses
- *In vivo* cellular and biomolecular responses
- Photodynamic therapy and immune responses
- Localized thermal effect on immune systems
- Immunological mechanism of laser therapies
- Combination of laser therapy and immunoadjuvants
- Laser induced cell proliferation and apoptosis
- Detections of molecular interaction in immune responses
- Clinical trials of photo-immunotherapy

The very first conference attracted renowned researchers around the world. They presented exciting talks in the following sessions:

- Session 1: Novel Combination Therapy in Cancer Treatment
- Session 2: Clinical Studies: Induction and Detection of Immunological Responses
- Session 3: Mechanism of Laser-Induced Immune Responses I
- Session 4: Mechanism of Laser-Induced Immune Responses II
- Session 5: Detection of Laser-Induced Cellular and Immune Activities I
- Session 6: Detection of Laser-Induced Cellular and Immune Activities II

Throughout the years, BPIR was attended by increasing numbers of individuals from different disciplines, either as presenters or as audience members. The attendance was relatively stable in the first five years and experienced noticeable growth in the past five years. The following chart shows the numbers of papers presented per year over the past 10 years.

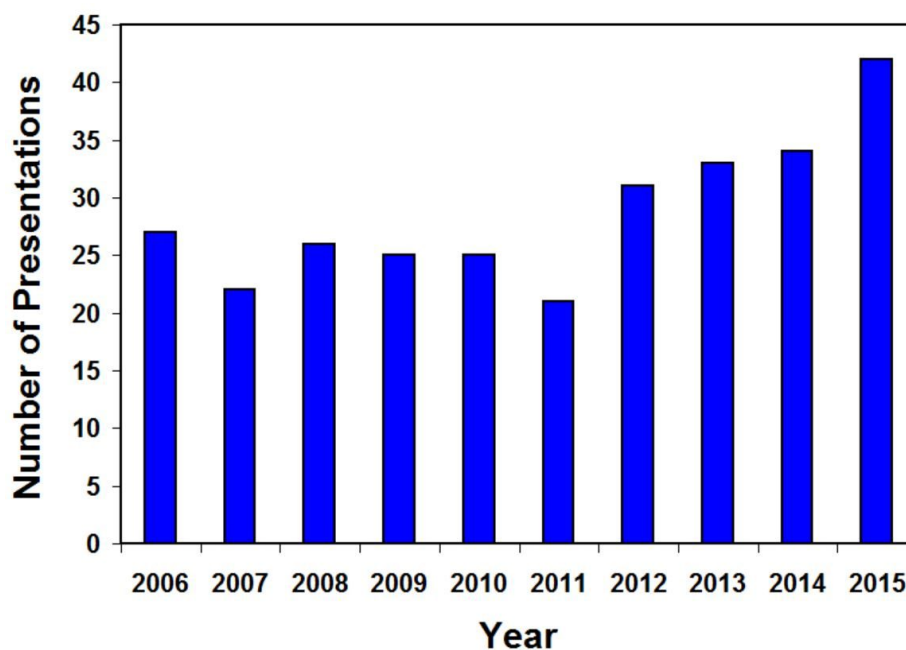


Figure 1. The number of presentations (oral and posters) at *Biophotonics and Immune Responses* from 2006 to 2015.

Participants included not only scientists and clinicians, but also patients who benefited from our research. Additionally, among the participants of our early meetings were inventors and entrepreneurs. Almost from the very beginning of BPIR, research collaborations began among researchers from different fields, and alliances were formed between the researchers and the entrepreneurs.

In January 2007, two groups of people with vastly differing backgrounds met at the second BPIR. Robert Nordquist and Wei R. Chen had been working since the early 1990s on a novel cancer treatment therapy – laser immunotherapy, and Tomas Hode and Peter Jenkins had been working on the development and manufacture of medical lasers. Their mutual interests attracted them to the conference. The interactions between the two groups were a perfect match, since they clearly saw the complementary nature of each other's professional and business endeavors. In the following year, Immunophotonics, Inc. was formed. Together, they began an intensive, joint effort to develop a new approach to treat late-stage, metastatic cancer patients who face severely limited therapeutic options. Today, the new approach, named *in situ* therapeutic cancer vaccine (inCVAX), is in the early stages of a rigorous development and approval process in the United States. This approach has already obtained encouraging outcomes in preclinical studies and preliminary clinical trials in Latin America.

Looking back, BPIR has indeed served extremely well in its intended role as a “bridge between technology development and clinical applications”. It continues to maintain its diversity by incorporating new topics and attracting more participants. The latest several conferences include the following sessions:

- *In Situ* Immunotherapy - Clinical Studies
- Selective Photothermal Effects
- Laser-Nanotechnology in Cancer Treatment
- *In Vivo* Imaging of Immune Activities
- PDT and Vaccine
- Novel Detection Technology and Nanotechnology
- Light, Cancer, and Immune Responses - Past, Current, and Future
- PDT and Immune Responses
- Laser Immunotherapy
- Monitoring Immune Activities
- Nanotechnology and Immune Responses
- Novel Optical Technology

Again, with great excitement and anticipation, we organized and conducted our tenth meeting. In celebration of our tenth anniversary, we included several invited talks covering the conference background, one of which was presented by Steven Jacques, a pioneer in biomedical optics research. He is well known as the founder of the famous conference *Laser-Tissue Interaction* 26 years ago, which has served, and continues to serve, as an incubator for many new ideas and new conferences, including BPIR. It was quite fitting that Steven Jacques provided an overview of the light application in diagnosis and therapeutic/surgical techniques. As promised, his presentation enlightened the audience and was an excellent way to start off the conference.

Biophotonics and Immune Responses was motivated, in a large sense, by the immunological studies in PDT. It was therefore appropriate that Tayyaba Hasan, one of the leading researchers in PDT, gave an overview of the field: its past, present, and future. Her talk was well received by all participants.

The presentation by Michael Hamblin, a leading expert on laser induced immune responses, provided an overview and an outlook of preclinical studies in the field. Mark Naylor, a dermatological oncologist and an early enthusiast of photoimmunotherapy, summarized the current clinical status using photoimmunotherapy in the treatment of several different metastatic cancers. In Tomas Hode's presentation, as shown to attendees, was a joint journey to develop a cancer vaccine. This journey started at one of the earlier BPIR conferences, with both promises and challenges in developing a new cancer therapy from a naïve bench-top concept to a viable bedside clinical tool.

Many well-known researchers from around the globe presented excellent talks on a variety of topics. These included Sandra Gollnick, Zheng Huang, Mladen Korbelik, Richard Levenson, Xunbin Wei, Mei Xu, and Zhihong Zhang.

Of course, the success of our conference would not be possible without the continued efforts of the members of the Program Committee. They organized sessions, presented talks, and contributed to the proceedings. The following committee members for our 2015 meeting deserve a special appreciation:

- Gianfranco L. Canti, Univ. degli Studi di Milano (Italy)
- Sandra O. Gollnick, Roswell Park Cancer Institute (United States)
- Yueqing Gu, China Pharmaceutical Univ. (China)
- Michael R. Hamblin, Wellman Ctr. for Photomedicine (United States)
- Tomas Hode, Immunophotonics, Inc. (United States)
- Yih-Chih Hsu, Chung Yuan Christian Univ. (Taiwan)
- Zheng Huang, Univ. of Colorado, Denver (United States)
- Vyacheslav Kalchenko, Weizmann Institute of Science (Israel)
- Mladen Korbelik, The BC Cancer Agency Research Ctr. (Canada)
- Mark F. Naylor, Dermatology Associates of San Antonio (United States)
- Karl-Goran Tranberg, CLS Ltd. (Sweden)
- Valery V. Tuchin, N.G. Chernyshevsky Saratov State Univ. (Russian Federation)
- Xunbin Wei, Shanghai Jiao Tong Univ. (China)
- Da Xing, South China Normal Univ. (China)
- Zhihong Zhang, Huazhong Univ. of Science and Technology (China)
- Vladimir P. Zharov, Univ. of Arkansas for Medical Sciences (United States)

Overall, due to the efforts of all program committee members, the speakers, and the participants, we had another successful meeting. We look forward to many more in the future!

**Wei R. Chen**

