Low-Level Light Therapy: Photobiomodulation

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Introduction to the Series

Since its inception in 1989, the Tutorial Texts (TT) series has grown to cover many diverse fields of science and engineering. The initial idea for the series was to make material presented in SPIE short courses available to those who could not attend and to provide a reference text for those who could. Thus, many of the texts in this series are generated by augmenting course notes with descriptive text that further illuminates the subject. In this way, the TT becomes an excellent stand-alone reference that finds a much wider audience than only short course attendees.

Tutorial Texts have grown in popularity and in the scope of material covered since 1989. They no longer necessarily stem from short courses; rather, they are often generated independently by experts in the field. They are popular because they provide a ready reference to those wishing to learn about emerging technologies or the latest information within their field. The topics within the series have grown from the initial areas of geometrical optics, optical detectors, and image processing to include the emerging fields of nanotechnology, biomedical optics, fiber optics, and laser technologies. Authors contributing to the TT series are instructed to provide introductory material so that those new to the field may use the book as a starting point to get a basic grasp of the material. It is hoped that some readers may develop sufficient interest to take a short course by the author or pursue further research in more advanced books to delve deeper into the subject.

The books in this series are distinguished from other technical monographs and textbooks in the way in which the material is presented. In keeping with the tutorial nature of the series, there is an emphasis on the use of graphical and illustrative material to better elucidate basic and advanced concepts. There is also heavy use of tabular reference data and numerous examples to further explain the concepts presented. The publishing time for the books is kept to a minimum so that the books will be as timely and up-to-date as possible. Furthermore, these introductory books are competitively priced compared to more traditional books on the same subject.

When a proposal for a text is received, each proposal is evaluated to determine the relevance of the proposed topic. This initial reviewing process has been very helpful to authors in identifying, early in the writing process, the need for additional material or other changes in approach that would serve to strengthen the text. Once a manuscript is completed, it is peer reviewed to ensure that chapters communicate accurately the essential ingredients of the science and technologies under discussion.

It is my goal to maintain the style and quality of books in the series and to further expand the topic areas to include new emerging fields as they become of interest to our reading audience.

James A. Harrington
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Preface

For almost 50 years, the medical therapy formerly known as "low-level laser therapy" and now known as "photobiomodulation" has had a somewhat checkered history. This approach has been promoted by some of its aficionados with almost missionary zeal, while doubters and skeptics have regarded it as "junk science" and "alternative and complementary medicine." This Tutorial Text intends to convey to the contemporary scientific reader that photobiomodulation is becoming increasingly well-founded based on the accepted principles of photochemistry, cellular and molecular biology, and physiology.

The text covers in some detail the basic mechanisms of action of photobiomodulation at the cellular and molecular level because we have found that by far the question posed most often by scientists outside the field is "How does it really work?" The well-known biphasic dose response is covered because we believe that failure to take account of this phenomenon contributes to many of the negative studies that have been published. The ability of photobiomodulation to be used as a pre-conditioning regimen before some medical or surgical procedure or for performance enhancement is intriguing.

This Tutorial Text (larger than most) includes original and previously published material. The majority of the book focuses on a critical analysis of the various diseases and disorders of different human and animal tissue and organ systems that can be beneficially treated by photobiomodulation therapy. Chapters cover well-established applications in muscles and orthopedic conditions (bone, tendon, cartilage). Applications of photobiomodulation in dentistry have historically been important because dentists are accustomed to using lasers and light sources in their clinical practice. In addition to the foregoing, more systemic disorders are addressed, such as stem cells, lymph flow and edema, and laser irradiation of blood. One of the most important growing areas of medical application is photobiomodulation to the brain. Many common disorders—such as stroke, traumatic brain injury,

psychiatric diseases, and dementia—may all benefit. Finally, one of the commercially successful areas of photobiomodulation involves its applications to aesthetic medicine, including skin appearance, hair regrowth, and fat removal.

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