Preface

Liquid crystals in biomedical applications: pathways to new opportunities

For more than 100 years, the liquid crystal science has grown and flourished; fueled, especially in recent decades, by the display industry. A number of renowned researchers have gone so far as to declare that the field is undergoing a "renaissance." The many advancements in the past decade have enabled liquid crystal devices to penetrate nearly all fields of optics, including displays, telecommunications, and now transcending upon the medical field in a variety of ways.

Similarly, biomedical engineering is a field rapidly gaining traction as one of the most engaging and challenging areas of research in our times. Interactions between scientists, engineers and physicians are resulting in ground breaking advancements capable of replacing many of the seemingly archaic practices still found in the medical setting today. Whether it is the development of a lab-on-a-chip (the biological equivalent to the integrated circuit) or new means of high resolution, *in vivo* imaging, all of society stands to benefit from the breakthroughs being made in this field. The problems are often too complex to solve alone, so highly interdisciplinary research teams are required to solve some of the most challenging problems facing scientists, engineers, and physicians today.

The "marriage" between physicians, engineers and scientists is proving to be of great value, not only for the revolutionary advances it provides for the physicians, but also for the researchers, who are learning about new aspects of their respective fields and the fields of their collaborators. The power of interdisciplinary thought has, in recent years, been pushed to the forefront of the scientific community as one of the most powerful means by which significant advances can be made. The divisions that have long stood

between biologists, chemists, engineers and physicists are being stripped away in favor of working together and applying the resident knowledge of each field to the others.

We have identified the value of interdisciplinary actions between the fields of liquid crystal research and technology and biomedical engineering. In preparing this book, we have outlined the various advances the liquid crystal community has provided the biomedical sciences and discuss the even greater potential of future investigations. This book specifically highlights medical displays (Chapter 2); spectroscopy, microscopy and hyperspectral imaging (Chapter 3); biosensors (Chapter 4); liquid crystal lasers (Chapter 5); biomimicking (Chapter 6); and actuators and drug delivery systems (Chapter 7). Each chapter reviews the advances that have been made by the time this book was written, and goes on to discuss the value of liquid crystals to the biomedical community.

We have prepared this book with a broad audience in mind; liquid crystal researchers, biomedical engineers and physicians have all been identified as individuals who could greatly benefit from the broad presentation of information in this text. This book is intended to provide a broad review of the potential of the interdisciplinary research already performed, balancing basic science, engineering and biomedical applications.

Orchestrating the text: a new manner of experiment

The Display and Photonics Laboratory in the Division of Engineering at Brown University has followed one primary research thrust since its inception — liquid crystal systems for novel applications. However, in recent years a paradigm shift has taken place in the target of its knowledge base, redirecting a portion of the focus from electro-optic devices for communications, optical systems and displays to the realm of biomedicine and biotechnology. In a sense, we have also undergone a renaissance.

Going beyond the traditional path of researching new topics and expanding their interests, the members of the laboratory, the editors included, have become experts in their respective fields and have put their knowledge to use in assembling this text. In ascertaining the scope of a field — what has been done? What is being done? What should be done? Any researcher must perform extensive literature searches and become intimately familiar with the background of their research topic. While understanding the research progress of the past, the authors have dissected the potential

of their field and have here communicated the necessity for further research in this area.

While many scientific texts draw upon the resources and backgrounds of researchers from across the globe, we have opted for a seemingly converse approach. The co-authors of the chapters consist of members of the Display and Photonics Laboratory at Brown University and local physicians associated with the Brown University Medical School, each performing research into liquid crystal systems with a primary focus on biology and medicine. The Display and Photonics Laboratory has recently undertaken numerous interdisciplinary collaborations with doctors from neighboring hospitals, including Rhode Island Hospital in Providence, RI and Memorial Hospital in Pawtucket, RI; in these interactions the core engineering knowledge base of the Brown University faculty and graduate students is fused with the interests of practicing clinicians. This proactive and dynamic approach of applying a core set of technologies to solve medical problems has the potential for great societal impact. These interactions, and the value generated from them, were the motivation for this book.

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