

# Preface

## About the book

This book is intended to provide the reader with the basic concepts, an overview of the experimental techniques, a broad range of case studies and the main theories, relevant to laser chemistry. The text has been written at a level suitable for final-year undergraduate students studying chemistry, physics or chemical engineering. In addition, we hope that it will be useful to graduate students studying for their Masters or PhD degrees in scientific fields related to, or involving, laser techniques and fundamental or practical aspects of chemistry. Of course, we also hope that colleagues in our profession, who are new to the field of laser chemistry, may find it enjoyable and useful to read.

In writing this book we have concentrated on molecular mechanisms and the fundamental nature of the phenomena under study. Wherever possible we emphasize the basic science rather than presenting overlengthy derivations or rigorous mathematical treatments. Where necessary, more detailed treatments and important key issues are presented separately in boxes that are highlighted; a novice reader could initially leave out such advanced material, without any serious loss of understanding. Throughout the text we have endeavoured to achieve a sensible balance in the presentation of the experimental facts, fundamental points and mathematical descriptions necessary to understand the general field of laser chemistry. Above all we have tried to maintain clarity in the presentation and discussion of the topics that are covered.

Every effort has been made to cover the most important areas of chemistry in which lasers play a significant role or have driven the development of new knowledge. Thus, after introducing the basic concepts and methodologies, we systematically present and discuss examples in analytical chemistry, spectroscopy, reaction dynamics, cluster and surface reactions and environmental chemistry; a dedicated section on applications is given at the end of the book. We have given only a brief presentation of areas that are still very much in a state of flux, such as coherent control or the use of attosecond and free-electron laser sources; for these topics, up-to-date key findings will be provided on the frequently updated web pages that are associated with this book [www.wileyeurope.com/college/telle](http://www.wileyeurope.com/college/telle). Once a particular field has settled down, we will aim to include further information in future revisions of the book.

The book is divided into seven distinct parts and these are subdivided into individual chapters. In Parts 1–3 we present the general principles that underpin the operation of lasers, the key properties of laser radiation, the main features of the various laser sources, and an overview of the most commonly used laser spectroscopic techniques, together with the instrumentation and methods for data acquisition. In Parts 4–6 we address the principles of unimolecular, bimolecular, cluster and surface reactions, which have been probed, stimulated or induced by laser radiation. In the final part, Part 7, we summarize a range of practical laser applications in industry, environmental studies, biology and medicine, many of which are already well established and in routine use.

The reader will notice that only a handful of worked examples and representative problems are embedded in the text. This is deliberate and not an omission; we found that the range of sensible examples that were needed, to aid the understanding of basic concepts and the practical application of laser procedures, were not easy to formulate without providing meaningful data sets. Clearly, the inclusion of lengthy data columns into a text was not an attractive prospect. Therefore, we have opted to provide examples, relating to the various chapters (with solutions

on request), on the Web pages associated with the book; this approach will allow updating and expansion of the examples. We also invite you, the reader, to contribute suitable examples and problems to these web pages (in consultation with the authors).

Exploiting the capabilities that a Web page can offer, we also provide some additional material, e.g. graphs, figures and images, which benefit from the use of colour. We also endeavour to make available, through links on the web pages, some key publications to make it easier for the reader to appreciate certain milestones in the development of laser chemistry.

## Acknowledgements

We would like to thank all of our students and colleagues for their enthusiasm, hard work and many stimulating contributions to our understanding of laser chemistry. We also thank our colleagues for providing welcome suggestions on how to improve and rationalize the content of this book. We are indebted to the editor, Andy Slade, who was always there for us with advice and help during the development of the manuscript, and who showed never-ending patience with us when yet another delay occurred in finalizing a particular chapter. One of us (AGU) thanks A. Vera and A. Garcia for typing part of the manuscript and J.B. Jiménez for his assistance with some of the Figures. Finally, without the goodwill of our families, who suffered with us through the long hours of the night and frantic weekends, this book would never have been written; our gratitude and appreciation goes to them.

**Helmut H. Telle**  
**Angel González Ureña**  
**Robert J. Donovan**

September 2006