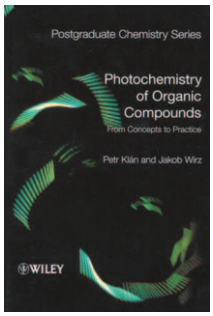
Photochemistry of Organic Compounds

Browsing through this book, one easily recognizes why photochemistry is on one hand a fascinating research area in chemistry, but on the other hand a problematic area for teaching. Besides organic photochemistry, which occupies the major part of the book (more than 200 pages), there are chapters on quantum chemistry, providing the theoretical basis for understanding electronically excited states, surface crossing, and IC and ISC processes, on spectroscopic methods, both static and time-resolved, on the kinetic analysis of complex photochemical processes, and on short-lived intermediates, their detection and structural analysis. Each of these different aspects often forms the subject of a single comprehensive textbook, and they seldom appear together in one text. This multifaceted character makes photochemistry a very attractive but also highly demanding subject.

The first chapter is a collection of great ideas and reasons to read this book and, in general, to enter this field of chemistry as a student or a researcher. The somewhat mysterious effect that, by simply absorbing a UV/Vis photon, a molecule becomes something different, and in many cases behaves in a way completely opposite to that of its ground state, is rationalized by an elementary excursion into quantum mechanics. Students who are familiar with the frontier molecular orbital model through frequent use should easily understand this. The authors entitle the second chapter "A Crash Course in Photophysics", and in it they describe elementary (photo)physical processes, explain laws, rules and principles, kinetics, quantum yields, selection rules, and energy-transfer processes, and discuss photochemical reaction pathways using the diabatic/adiabatic terminology. I do not agree with the authors that this is a crash course. Typically, after a crash course one can use a spectrometer without being aware of technical details or pitfalls, whereas Chapter 2 includes a careful description of many physical details and introduces much deeper considerations. In the third chapter, the authors describe experimental techniques and methods for performing and analyzing photochemical reactions, providing a valuable collection of static and time-resolved tools that every photochemist should be aware of (and should at least know the right colleague who can handle them). The rather short Chapters 4 and 5 shine light on two aspects of the analysis of photochemical reactions and reactivity: quantum-mechanical models of electronic excitation, and photochemical reaction mechanisms and reactive intermediates. The didactical strength of the text is strikingly evident when, for example, one reads the introduction to Chapter 5: "What is a reaction mechanism?". The special competence of the authors in mechanistic physical organic chemistry makes this part of the book a pleasure to read.

The central part of the book, as already mentioned, is Chapter 6 on the chemistry of excited molecules. It follows a traditional sequence, by dealing with alkenes and alkynes, arenes, carbonyls, compounds containing nitrogen, sulfur, or halogens, and molecular oxygen, and ending with a discussion of photosensitizers, photoinitiators, and photocatalysis. All these subchapters are constructed on the same principle, which is briefly described below for the section "alkenes and alkynes", and begins with a collection of the necessary photophysical data (absorption and emission properties, lifetime of excited states, intersystem crossing, and triplet properties). After a table summarizing the important reaction types of excited alkenes and alkynes comes a description of the *E*/*Z* photoisomerization of alkenes. This process is important in synthetic organic chemistry and in photobiology, the mechanism of vision, and the function of the green fluorescent protein. In order to teach these diverse aspects of one process, the authors use two attractive devices: "Case Studies" and "Special Topics". Whereas the Case Studies describe real synthetic applications with valuable experimental details from original research papers, the Special Topics are often linked to (photo)-biological problems; for example, in the alkene chapter these are concerned with vision, phototherapy, photoproduction of vitamin D, photochemistry of DNA, and photochemotherapy. This is useful and helps the reader to understand the importance of the processes and their roles in nature. With regard to organic photochemistry and the possible applications for synthesis, the book presents a well-balanced mixture of historically relevant reactions, mechanistically important investigations, and topical papers that offer new applications. In particular, stereoselective reactions have gained an important position in modern photochemistry, either in diastereoselective or (induced or absolute) enantioselective mode. Many different aspects of photochemistry in constrained media, in the solid state, in microemulsions, in ionic liquids, or in chiral supramolecular host–guest complexes are also described. Photochemistry can often be used as a tool for molecular switching when applied to photoactivating or protecting groups, photoinitiators, photosensitizers, or photocatalysts. Photochemical processes can also be used for the reading and writing of information (e.g., photography, holography) or simply for the production of light (e.g., in OLED applications). These modern technical aspects are also mentioned in special topics throughout the text.



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At the end of the book there is an informative and well-structured analysis of retrosynthetic steps in photochemistry, offering the prospect of further applications in organic synthesis. With regard to mistakes, there are only a few in this brilliant textbook. This is absolutely remarkable when one takes into account the flood of schemes (the di-epoxide transformation in Scheme 6.262 would have interesting synthetic applications) and figures, and the amazing number of literature references (1574, many of which are from 2007 and 2008).

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