

Acid Catalysis in Modern Organic Synthesis

“Acid is one of the oldest, but the most important catalyst for organic synthesis”. That is the starting sentence of this book by Yamamoto and Ishihara, which follows their earlier book “Lewis Acids in Organic Synthesis (2000)”, and covers the new developments in the field up to 2006.

Who does not remember their first organic syntheses in school or during the first year of university studies, in which an evil-smelling carboxylic acid and an alcohol were converted into a fragrant-smelling ester by the action of just a single drop of sulfuric acid? However, after G. N. Lewis re-defined acids in 1916, they became more than just a source of H^+ : Lewis extended the concept of acids to include compounds that are able to form an adduct with an electron pair of another molecule. Thus, modern synthetic chemistry is not limited to H^+ , even though “designer acids” such as chiral phosphoric acids have led to a renaissance of Brønsted acid catalysis over the last few years. Today the synthetic chemist is offered a plethora of Lewis acids. In addition to classical Lewis acids such as BCl_3 , $AlCl_3$, and $TiCl_4$, nowadays we are presented with innumerable alternatives possessing valuable properties. For example, $Sc(OTf)_3$ and many of the lanthanide salts tolerate humidity, and have even been successfully employed in water as the reaction medium, while other systems sometimes display new special properties.

In the present compendium, Yamamoto and Ishihara have coordinated this great diversity of know-how by sorting Brønsted and Lewis acid catalysis into 19 chapters written by 39 authors who are experts in their fields. In an introductory chapter about “combined acids”, Yamamoto and Futatsugi describe the development from 2000 to 2006 of the method of catalysis with two acids, where an achiral Brønsted or Lewis acid assists a chiral second acid. The following 17 chapters are arranged according to the Periodic Table, starting with catalysis by H^+ . While some of the classical Lewis acids, such as B^{III} , Al^{III} , and Ti^{IV} , are treated in separate chapters, others are covered in combined chapters, such as that on magnesium in combination with calcium and zinc, or that on 15 transition metals from vanadium to platinum. The book concludes with a chapter about polymer-supported acids, where examples of catalysis by immobilized Lewis acids are summarized so that the reader does not have to search for them throughout the whole book.

Originating from the book’s concept of classifying the content by elements, each author focuses on “his” own Lewis acid and its chemistry. There

are only a few cross-comparisons with other elements, in which an author compares the performance of one compound with that of other Lewis acidic elements for a given reaction. However, this is compensated for by the fact that the chosen concept is perfectly suited to provide a rapid overview about the chemistry of a specific element. For classical Lewis acid catalyzed reactions such as aldol or Diels–Alder reactions, the reader has to seek the relevant paragraphs in many different chapters, and therefore someone looking for one of these specific reactions might prefer to consult a specialized monograph or review. Furthermore, it should be noted that most chapters focus on the description of catalytic applications using substrates that coordinate through a heteroatom to the Lewis acid center, whereas the activation of C–C multiple bonds is not discussed so thoroughly.

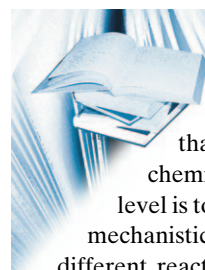
To summarize, *Acid Catalysis in Modern Organic Synthesis* is an excellent reference book that should be available in every well-equipped chemistry library. It will certainly be helpful for many scientists as a guide through the ever-growing jungle of acids for catalysis.

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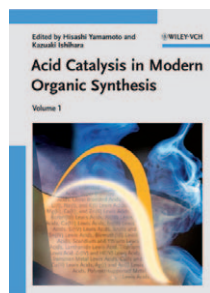
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Arrow Pushing in Organic Chemistry

One of the central challenges that every instructor of organic chemistry faces at the undergraduate level is to properly convey the underlying mechanistic harmony that pervades the different reactions of chemical synthesis, particularly to an audience that often largely consists of students whose interest is low because they are merely fulfilling a requirement and/or believe that rote memorization is the best way to master the material. This new text from Daniel Levy, *Arrow Pushing in Organic Chemistry*, was deftly designed with these challenges in mind. Over the course of eight chapters, Levy provides a well-written précis of the main topics in introductory organic chemistry, focusing in particular on bond polarization, resonance, and fundamental arrow pushing, to illustrate just how unified organic chemistry is at a mechanistic level. Each chapter then concludes with a series of 20 to 30 well-conceived problems for students to practice the key topics highlighted in the preceding pages.



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1+2. Edited by Hisashi Yamamoto and Kazuaki Ishihara. Wiley-VCH, Weinheim 2008. 1112 pp., hardcover € 399.–, ISBN 978-3-52731724-0

Overall, the strengths of this text are profound. Firstly, the book can be easily incorporated into any course, irrespective of the continent where it may be taught, since it has been created specifically as a supplementary text, with the goal of reinforcing and/or amplifying core concepts that are taught in most courses. Indeed, the book is nicely organized by major topics, with various subsections such as acid/base theory and S_N2 versus S_N1 reactions, so that students can easily navigate between different chapters at will to coincide with the particular ordering of subjects that their instructor has chosen or that their main textbook provides. Having reviewed over a dozen organic texts myself, I think that this book would certainly work well with every major introductory book currently in print. Secondly, the text is extremely user-friendly: 1) problems are well spaced with plenty of room for each one to be solved right on the page, 2) the answer key in the appendix provides not only the answer in graphical form, but also a nice textual play-by-play with references to other chapters and sections if a student needs more practice, and 3) there is a detailed and highly accurate index that is easy to search. Finally, the book accomplishes its goal of conveying the unity of organic mechanism. When I first took organic chemistry well over a dozen years ago, I used Daniel Weeks' *Pushing Electrons* to help supplement the core mechanistic instruction that I received. I still recommend that book to my students today, because it is an excellent primer on resonance and basic arrow pushing. However, this text by Levy goes much further. It provides more problems, more depth, and more difficulty, especially with reactions that students are likely to encounter only at the tail end

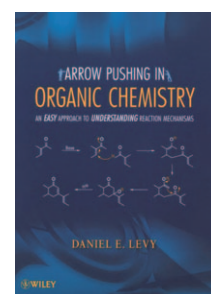
of their courses; it is also the first book I have seen that effectively conveys the unity of reaction processes through a modicum of text.

If there is any main weakness to the book, I would argue that reactions which students typically find the most difficult to grasp, such as aldol condensations and Robinson annulations, are not covered in as much detail as I might have hoped for, in the sense of providing exceptionally useful aids to reinforce my instruction on these topics. The same is true for pericyclic reactions. Finally, the structural formulas sometimes suffer from a lack of clarity through the combined use of line-bond structures with fully defined motifs, the absence of lone pairs on many heteroatoms, and the use of partial charges and formal charges within the same structure. Nevertheless, these are minor defects on a global scale, and I will definitely recommend this text to my undergraduate students as an additional resource for gaining expertise in the fundamentals of mechanistic thinking.

In summary, *Arrow Pushing in Organic Chemistry* fills an important gap in undergraduate education, and I would encourage every instructor of organic chemistry to seriously evaluate this text, as there is a strong likelihood that it will serve as a substantive aid. This book is definitely well worth its price!

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Arrow Pushing in Organic Chemistry
An Easy Approach to Understanding Reaction Mechanisms. By Daniel E. Levy. John Wiley & Sons, Hoboken 2008. 302 pp., softcover € 32.90.—ISBN 978-0470171103