Organic Process Research & Development

BOOK REVIEW

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Book Review of Handbook of Green Chemistry, Vols. 4, 5, and 6, Green Solvents

Handbook of Green Chemistry, Vols. 4, 5, and 6, Green Solvents. Edited by Paul T. Anastas.. Volume 4: Supercritical Solvents (Walter Leitner and Philip G. Jessop, Eds.), 495 + xxiii pp. Volume 5: Reactions in Water (Chao-Jun Li, Ed.), 427 + xviii pp. Volume 6: Ionic Liquids (Peter Wasserschied and Annegret Stark, Eds.), 352 + xxv pp.Wiley-VCH: Weinheim, Germany. 2011. Price £410. ISBN 978-3-527-31574-1.

The last 3 volumes in the 6 volume *Handbook of Green Chemistry* are all concerned with Green Solvents. Volume 4 on Supercritical Fluid (SCF) solvents begins with a short introduction from the editors which emphasises the motivation for use of SCFs and the hazards of working with them under pressure, as well as environmental and reactive chemistry benefits, particularly solubility of gases in SCFs. For this reason industrial use of SC CO_2 in chemical reactions (as opposed to extractions) has been in catalytic hydrogenation.

Chapters on equipment, SCF properties, catalysis (including biocatalysis as well as heterogeneous catalysis), synthesis, polymerisation, photochemistry, electrochemistry, phase-transfer catalysis, and chemistry in near- and supercritical water mean that this is a comprehensive picture of the current state of the art in supercritical fluids as solvents. For industrial readers, however, the lack of a full chapter covering the details of the few processes which have been commercialised is a serious omission. None of the chapter authors are from industry so nowhere is the industrial perspective on SCF use given.

The same criticism can be given of the other two volumes, although Volume 5 (Reactions in Water) does have one chapter by Peter Dunn of Pfizer on "Water as a Green Solvent for Pharmaceutical Applications". This chapter is an excellent summary of work at Pfizer and elsewhere on green processes for pregbalin, statins, oseltamivir, sildenafil, lumiracoxib, etc. In addition, the following chapter on "Water as a Green Solvent for Bulk Chemicals" seems to have promise but, in fact, goes over the old ground of hydroformylation processes in water and the Kuraray 2,7-octadien-l-ol process with little new insight.

Earlier chapters in Volume 5 cover green acid catalysis in water, green bases, oxidations, reductions, coupling reactions, pericyclic reactions, carbohydrate chemistry, etc. as well as "on water" reactions. Microwave reactions, ultrasound, and photochemistry are also covered in one chapter. Overall this is an excellent up-to-date coverage of the subject.

The final volume on ionic liquids discusses ionic liquid (IL) synthesis, Green Synthesis using ILs, ILs in Green Engineering, and finally ILs and the environment. Some industrially interesting aspects include use of ILs in electrolyte systems, as lubricants, in absorption chillers, in cellulose processing, and in the manufacture of 5-hydroxymethyl-furfural from saccharides. With the high price of ILs demanding reuse and recycling of ILs, many in the fine chemicals industry will be put off using them. BASF, however—with their BASIL process and also their use in cellulose processing—are one company who seem determined to move ahead with commercialisation of products/processes using ILs.

Overall, these three volumes bring readers up-to-date with the current thinking and new applications of green solvents and are recommended reading for scientists and engineers involved in green issues.

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10.1021/op200059s

Published: March 29, 2011