

Book Review

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**Handbook of elemental speciation,
handbook of elemental speciation II:
species in the environment, food,
medicine and occupational health**

Wiley, Chichester, 2005,
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This book forms the second of a two-part work on elemental speciation. The first volume, entitled *Handbook of Elemental Speciation: Techniques and Methodology* (ISBN 0-471-49214-0) was edited and compiled by the same experts and covered the analytical methodology used for the determination of elemental speciation. Although not the subject of the current review, the objective of the first volume was “to present a concise, critical, comprehensive and systematic (but not exhaustive), treatment of all aspects of analytical elemental speciation analysis”. As stated by the coordinating editor in Chapter 2 of the second volume of this Handbook “the second volume covers in detail the various aspects of 21 elements, of the actinides and of four groups of compounds (halogens, volatile metal compounds of biogenic origin, metal complexes of proteins)”. Both the volumes that make up this Handbook are required and it is certainly fair to say that Volume 2 would not provide a complete overview of the main principles of the ‘speciation approach’ on its own. At the time of writing, the first volume of this work was not available for review, so it is not possible to put the whole work in its true context. With that in mind the scope, content, accuracy, context and limitations of Volume 2 will be addressed in this review.

At nearly 800 pages, sub-divided into four parts, with a total chapter count of around 31 (depending on which sections are considered to be a separate chapter), it is certainly true that Volume 2, detailing *Species in the Environment, Food, Medicine and Occupational Health*, represents a significant achievement, both in coordinating the 53 contributors and making sure that the high potential for repetition in a work of this nature is kept to a minimum. In terms of subject coverage, as stated above, the body of the work focuses in detail on 21 different elements, some of the actinides and four groups of compounds (halogen compounds, volatile

biogenically derived compounds, humic complexes and important metal–protein species). The element-by-element chapters cover Al, As, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, PGE, S, Sb, Se, Si, Sn, Tl, V and Zn speciation. The final, smaller part of the volume (106 pages, 422 cited references) comprises two chapters covering modeling of elemental species (thermodynamic modeling of metal partitioning in the environment, modeling in nutrition, modeling of trace elements in health and disease) and speciation and emerging legislation.

The justification for which elements are covered and how comprehensively appears to be dependent on the individual contributors, presumably in conjunction with the editorial team. Obviously in a work of this type the available information for review will reflect the studies that have been carried out and over what time period the chemical species of a particular element have been investigated. For instance, mercury has been of great interest since the late 1960s when it was realized that it was readily methylated in the environment. This element therefore receives a detailed treatise covering 24 pages of text and 102 references, which is in contrast to the chapter dealing with speciation studies focusing on the essential trace nutrient manganese. The latter receives much less attention, with only four pages of text and 18 references, and reflects the much shorter time period over which the speciation of this element has been studied. A further reason for less information on this element, which is well made in the text, is that it is a very difficult element to study in this context because of its trace concentrations and the ability to really measure its chemical species has had to wait for the development of supremely sensitive analytical methods with limits of detection suitable for its measurement in biological samples. I have no problem with the inconsistency in the level of detail for each element discussed, and agree with the coordinating editor that the chapters should reflect both the “personal focus and academic background” of the specialist who wrote the particular chapter. However, the buyer of this volume should be aware that the chapters on Mn and Mo, and to some extent Si, are much shorter in page length and number of references cited compared with the coverage of the other elements

mentioned above. In my opinion the volume does what it sets out to do and covers a wide range of areas of interest (environment, food, medicine and occupational health) as well as an extensive range of elements and chemical groups. As such it provides the interested reader with a very broad introduction to a variety of areas where speciation is important.

So how accurate and comprehensive is the material presented in this volume? Obviously this is difficult to answer for every single element covered in the treatise, but the fact that the editors have been very active in this area of research for many years and that many of the contributors are recognized experts in the field must give one confidence that this represents the state of knowledge at the time the chapters were written. To illustrate this point, if we consider Chapter 2.20 on the speciation of tin (41 pages of text, 165 references cited), this chapter covers the following areas: chemical and physical properties of organotin compounds (OTC), toxicity of OTC (including effects on microorganisms, aquatic organisms, terrestrial animals, effects on humans and mechanism of action), production of OTC, application of OTC (PVC stabilizers, antifouling coatings, agricultural use and timber treatment), environmental fate of OTC (degradation, bioaccumulation, adsorption and biomethylation), occurrence and distribution of OTC in the environment (marine systems, freshwater, sediments, soils, organisms, humans), analytical methods for OTC and the legislative situation. This illustrates very well both the wide range of areas where metal speciation has an impact and also the coverage of one of the chapters detailing the speciation of an element that has been widely studied using speciation methods. The informative nature of this chapter has to be praised, with a range of methods to present the data dealt with in the text, including the use of diagrams, figures, tables, chemical structures, reaction pathways and analytical spectra, including chromatographic and mass spectral data. The discussion of the research carried out on organotin speciation is comprehensive and detailed, which is also the case for the other element-by-element chapters. The small points that could have been included in this chapter relate to: (1) the lack of discussion of the current state-of-the-art analytical methods involving the quantitation of OTC

by isotope-dilution methods—whilst this is mentioned in passing, this particular analytical approach is very well developed for this element (presumably it is discussed in Volume 1); (2) the omission of any details on OTC in the atmosphere, particularly their generation in land-fill sites where a number of studies have shown that some very interesting tin-containing compounds have been formed in this environment. One caveat to this final criticism is that these compounds are discussed in detail, but appear in a separate chapter (Chapter 2.25, Volatile Metal Compounds of Biogenic Origin), although there is a lack of cross referencing to help with finding this information and the index does not include an entry on volatile OTC specifically. To some extent this illustrates one of the features of this volume, which relates to the differences in style between the chapters which can make it difficult to locate information quickly. However, some might say that this makes for a more interesting and less 'dry' read.

Initially I thought the later chapter dealing with modeling (thermodynamic

modeling of metal partitioning in the environment, modeling in nutrition, modeling of trace elements in health and disease) was surplus to requirements. However, on considering the information in this chapter further, this part of the work was actually the most novel and useful. This area is really what is required from a toxicological perspective and is the major requirement before legislators can make truly informed decisions on the real relevance of the data generated from the studies described in the earlier chapters of the book. In the end this may be the most interesting read for researchers currently active in speciation analysis.

The minor criticisms I have of this volume relate to the omission of a summary of where we are going in speciation analysis. Inclusion of a chapter predicting new areas of study, or coverage of this in each separate chapter would have provided a more rounded overview of the subject area. From a technical perspective, it is a pity that the technique of electrospray mass spectrometry was not dealt with in some of the chapters, particularly those dealing with As and metalloproteins. The

combined use of elemental and molecular mass spectrometry will probably be one of the most useful tools, in conjunction with solid analysis techniques like the family of related X-ray absorption spectroscopy methods, to facilitate further elucidation of chemical speciation (perhaps this is covered in Volume 1). Overall it is very difficult to find fault with such a comprehensive treatise of the subject area that covers such a wide range of elemental species. Whilst it would be easy to identify specific research that could have been included, this would be unfair as this two-volume work represents the most comprehensive reference material on the subject. In conclusion, this set of books should definitely be available in the reference library of every university or organization where speciation studies are carried out.

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