

Book reviews

Gmelin handbook of inorganic chemistry, 8th edition, *Mo — Molybdenum, Supplement Volume B3a: Molybdenum Oxide Hydrates. Oxomolybdenum Species in Aqueous Solutions*, Springer-Verlag, Berlin, Heidelberg, New York, Tokyo, 1987, xvii + 360 pages, DM 1531. ISBN 3-540-93542-8.

Despite the slightly misleading claim on the cover that this volume deals with oxide hydrates and molybdate ions, it in fact deals with molybdenum oxide hydrates and oxomolybdenum species in aqueous solutions (n.b. chemical reactions in aqueous solution, and the species present in non-aqueous solutions and in ionic liquids, are to be described in Supplement Volume B3b). This is only the eighth volume which the Gmelin Institute has published concerning the chemistry of molybdenum (System No. 53), and the fourth describing molybdenum oxides and molybdate salts. There are still no volumes describing the coordination compounds or organometallic compounds of molybdenum, and this is indeed a sad omission which I hope will be rectified in the near future.

The volume is split into two sections. The first and shortest part (39 pages) begins with a brief overview of the molybdenum oxide hydrates (or, more correctly, oxide hydroxides), followed by detailed descriptions of the following compounds: $\text{Mo}(\text{OH})_3$, $\text{MoO}_{2-n}(\text{OH})_{2n}$, $\text{MoO}_{1.6}(\text{OH})_{1.6}$, $\text{MoO}_2(\text{OH})$, $\text{MoO}(\text{OH})_3$ and its dihydrate, $[\text{Mo}_2\text{O}_4(\text{OH})_2(\text{H}_2\text{O})_4] \cdot 6\text{H}_2\text{O}$, $\text{MoO}_n \cdot x\text{H}_2\text{O}$, H_xMoO_3 (the molybdenum "bronzes"), $\text{MoO}_3 \cdot n\text{H}_2\text{O}$, $\text{MoO}_2(\text{OH})_2$, $\text{Mo}_7\text{O}_{18}(\text{OH})_6$ and $\text{MoO}_2(\text{OH})(\text{OOH})$.

The second, longest, and most interesting section describes the oxomolybdenum species present in aqueous solution. A total of 27 pages are devoted to oxidation states +3, +4 and +5, and the mixed valence systems of molybdenum(III,IV) and molybdenum(V,VI), including molybdenum blue: oxomolybdenum(VI) complexes have 292 pages devoted to them. This very important area is treated thoughtfully, critically and clearly, and the authors (K.-H. Tytko and U. Trobisch) have performed a tour de force in their treatment of this difficult subject, for which many contradictory reports exist. Following a general overview, the authors discuss the quantities characterizing oxomolybdenum(VI) species (and aqueous solutions containing them), outline the nomenclature used in this area, and describe the methods used to investigate the nature of these species. Then, making extensive use of tabulated data, the components of the complex equilibria which are present in aqueous solution are discussed, involving both monomeric and polymeric species, and this section is concluded by a compilation of the measured equilibrium constants. There then follows a critical account of the components of the equilibria, and the relationship between them, including invaluable distribution, predominance and existence area diagrams. After a detailed treatment of the formulae, structures and physical and chemical properties of individual oxomolybdenum(VI) species, the volume concludes with a remarkable and scholarly treatment of the theoretical

investigations and considerations on the structures, formation mechanisms, stability and acid–base properties of the polymeric species.

One cannot help but be filled with admiration for this work. If the Gmelin Handbook has a detectable weakness in its structure, it is that it tends to concentrate on individual compounds and sometimes loses the more general picture. This volume is a model of how such pitfalls can be avoided. The volume is the usual professional product which one expects for this series, and it is without peer, both as a source of factual data and as a definitive text upon an extremely complex area of chemistry. This book must be purchased by all academic and industrial research libraries: it is expensive, but is also invaluable.

*School of Chemistry and Molecular Sciences,
University of Sussex, Brighton BN1 9QJ, (Great Britain)*

Kenneth R. Seddon

Gmelin handbook of inorganic chemistry, 8th edition, *W—Tungsten, Supplement Volume A7: Metal, Chemical Reactions with Inorganic and Organic Compounds*, Springer-Verlag, Berlin, Heidelberg, New York, Tokyo, 1987, xxv + 410 pages, DM 1771. ISBN 3-540-93541-X.

This is the eighth volume of the Gmelin Handbook to describe the chemistry of tungsten (System No. 54) since the main volume was published in 1933. Of these, six have dealt (five exclusively) with tungsten oxide species, and none have yet considered the very important areas of the coordination and organometallic chemistry of tungsten. The current supplement volume (A7) describes the chemical reactions of metallic tungsten with both inorganic and organic compounds (reactions with metallic elements will be described in A6, and reactions with non-metallic elements will be described in A5). It should be noted, however, that this volume specifically excludes all reactions which result in the formation of organotungsten compounds. Thus, although one might have expected to find an important section upon metal vapour synthesis, this has been deferred until the long-awaited volume(s) upon the organometallic chemistry of tungsten appear. A majority of this volume is, perhaps not surprisingly, concerned with chemistry at the the surface of tungsten rather than the reactions of bulk tungsten, and is thus both topical and timely.

The first section (of five) in this volume deals, in 220 pages, with the reactions of tungsten with non-metal compounds (including water, H_2O_2 , N_2H_4 , NH_3 , nitrogen oxides, Group 17 derivatives (especially HX), sulfur compounds, H_2Se , boron compounds, carbon monoxide (91 pages; > 500 refs.), carbon dioxide, HCN, halocarbon derivatives, and a wide range of silicon, phosphorus and arsenic derivatives). The following section (80 pages) describes the reactions of tungsten with metal compounds (including Group 1 hydroxides, nitrates, nitrites, halides, oxides, and oxoanion salts, Group 2 oxides, nitrides, halides and carbonates, Group 12 compounds, Al_2O_3 , gallium compounds, lanthanide oxides and borides, and many binary compounds of the *d*- and *f*-block transition metals). The third section (20 pages) describes the reaction of tungsten with aqueous acids, alkalis and salts, whereas the fourth section (7 pages) deals with the reactions of tungsten with a range of miscellaneous inorganic reagents of industrial interest (including combus-