Gold—Progress in Chemistry, Biochemistry and Technology

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This book is a collection of 21 specialist chapters describing recent progress in gold technology (nine chapters), biochemistry (one) and chemistry (11). For various reasons, metallurgical aspects, theoretical chemistry, and physics and solid-state chemistry were excluded. It is a pity that a chapter on the influence of relativistic effects on gold chemistry was not available.

Because of my own interests, I turned to Chapter 10 first, 'The biochemistry of gold' by Shaw. This provides an excellent overview of recent advances, including the role of gold–protein complexes, generation of $[Au(CN)_2]^-$ (a potentially active metabolite of gold antiarthritic drugs) and gold(III) (perhaps the cause of toxic side reactions) *in vivo*. Shaw points to possible future developments concerning gold anticancer and anti-HIV agents. Clearly there is still much important mechanistic gold biochemistry to be done.

In Chapter 11, Strähle reviews gold(I) and gold(III) compounds with bonds to nitrogen. This is an informative and readable chapter. The mysteries of the chemistry of the highly explosive yellow solid formed by addition of ammonia to $HAuCl_4$ or gold(III) oxide (so-called 'fulminating gold') still remain. The structures and properties of N-centred gold clusters such as $[(Ph_3PAu)_5N]^{2+}$ (stabilized by aurophilic Au–Au bonding, and elegantly studied by the editor of this book) are discussed.

One of the editor's two chapters is on organogold chemistry (Chapter 18). This is an excellent comprehensive survey of nearly 100 pages with 489 references, and covers gold(I) complexes [RAuL], those with two Au–C bonds, gold(I), gold(II) and gold(III) complexes with ylide ligands, gold(III) complexes with 1–4 Au–C bonds, homo- and hetero-metallic Au clusters, and the synthesis and properties of alkyne–gold complexes. This area has developed rapidly in recent years and the presence of short Au–Au contacts in organogold(I) complexes is common. Oxidative addition to dinuclear bis(ylide) complexes gives rise to unusual bicyclic gold(II) compounds containing a discrete transannular Au–Au bond. Auration of aromatic rings to give monoaryl gold(III) species can be readily achieved. As noted by Puddephatt in Chapter 9 ('Gold metal and gold alloys in electronics and thin film technology'), organogold complexes are attractive precursors for chemical vapour deposition (CVD) of gold, often alkyl–, vinyl– or alkynyl–gold(I) complexes [R–Au–L], but also organogold(III) such as $[Me_3Au(PMe_3)]$. He also describes briefly the important area of self-assembled, oriented monolayers of alkylthiols on clean metallic gold surfaces with potential applications in microfabrication and microelectronics.

A fascinating property of many compounds with Au–Au interactions of less than 3.6 Å is their luminescence. In Chapter 21 (spectroscopic methods), Bowmaker discusses whether the likely absorption transition is ligand-to-metal charge transfer or a metal-centred $5d \rightarrow 6p$ transition. The phenomenon of 'solvoluminescence' is fascinating: colourless crystals of the cyclic trigold complex $[Au_3(CH_3OC{=}NCH_3)_3]$, previously irradiated with ultraviolet light, emit bright flashes of yellow light on contact with chloroform or acetone (the work of Balch and co-workers). Bowmaker points out that the only ^{197}Au NMR signals observed to date are for the metal and its alloys, although the solid-state ^{31}P NMR spectrum of chelated tetrahedral gold(I) bisphosphine complexes can exhibit four-line patterns due to $^1J(Au–P)$ spin–spin coupling.

In Chapter 15 Dyson and Mingos take us from the stable dimeric unit Au_2 (dissociation energy 228 kJ mol^{-1} in the gas phase) through small clusters such as $[Au_7(PPh_3)_7]^+$ to the giant $[Au_{39}(PPh_3)_{14}Cl_6]^{2+}$, and to colloidal gold itself. If you are interested in metallic gold, then there are chapters on alloys for dental and electromechanical use, ceramic decoration [which uses gold(I) thiolates similar to antiarthritic drugs], refining and recycling, jewellery (for which hardening by alloying is essential), coinage and mining.

As the editor says in his opening sentence, 'Gold is a lovely subject for everyone', but will everyone be able to afford to read about it? Unfortunately, at this price, access to the book will be highly restricted. Few individuals will be able to buy it and probably not many libraries either. Let us hope that the publishers can think of a way of making such excellent material more widely available.

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