Preface

The redox activity of the heavier chalcogens, sulfur, selenium and tellurium, has long been a focus of biological and medical interest. Thiols and selenoproteins, in particular, play a critical role in maintaining healthy states by scavenging excess oxidants that contribute to increased risk of cancer, cardiovascular disease and other oxidative-stress-related illnesses. To this end, natural sulfur and selenium compounds found in many foods and a number of small synthetic organosulfur, -selenium and -tellurium compounds have been explored for their potential role as chemopreventives. Sulfur, especially in the form of cysteine, is a biomarker for oxidative stress as well as a ligand in the active site of numerous metalloproteins, notably iron hydrogenase and transcription factors, where the conversion of thiolates to disulfides is an important redox switch. Thus, while the chemistry of ubiquitous oxygen is distinct and often studied separately, much of the biological chemistry of the heavier chalcogens are defined by their interaction with this lightest member of the group. Highlighting both the potential value and the pitfalls of chalcogens in biology and medicine, the National Institutes of Health has spent over $250,000,000 in the past decade on selenium-supplementation clinical trials alone, leading to mixed results and demonstrating the clear need for further basic research.

This book highlights the biological uses of heavy chalcogens as a key area of focus in bioinorganic chemistry and a unifying theme for research in a wide variety of disciplines. Recent achievements in these multidisciplinary efforts are presented that discuss the subtle, yet important roles of biochalcogens in living systems as sulfur- and selenium-containing metabolic intermediates and products (Chapters 1 and 10) and in their oxidation when coordinated to metals (Chapters 3 and 4). Chemical and instrumental tools for detecting sulfur and selenium species and their functionalities are also discussed (Chapters 2 and 6), as are new directions in biochalcogen applications to redox scavenging, both in terms of synthesis (Chapters 7 and 8) and mechanistic modeling (Chapter 9). Tellurium, with no natural biological function, is represented together with sulfur and selenium as a phasing agent in nucleic acid crystallography and for other biological studies (Chapter 5).

This book will serve as a useful collection of reviews and research results in this diverse field, encompassing research in bioinorganic chemistry, organic synthesis, computational approaches, and biochemistry; as an inspiration for researchers wishing to enter the variety of fields that encompass these multidisciplinary research efforts; and as a useful resource for undergraduate or graduate courses focusing on main group and transition element biochemistry. We hope that a wide audience finds this book a helpful resource for this rapidly expanding field.

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