Making Everything Easier!™

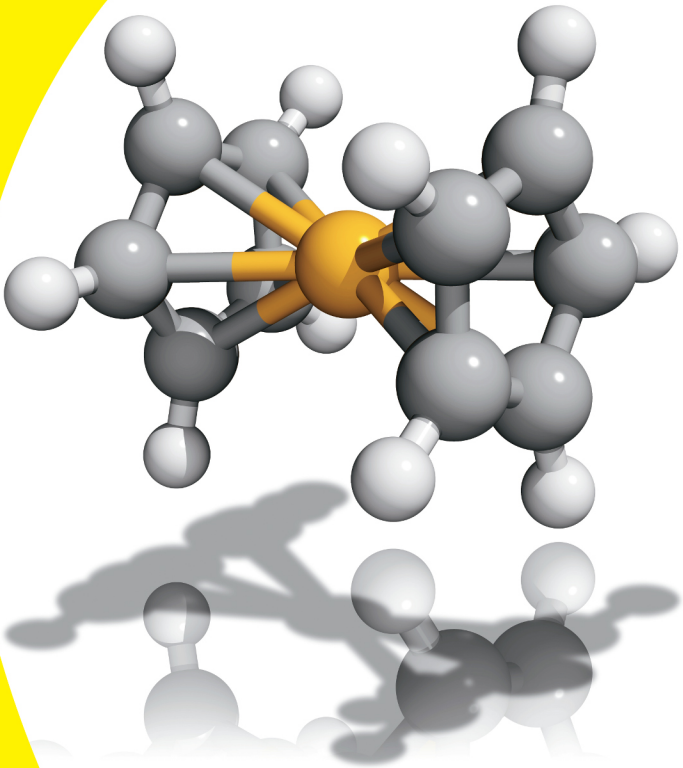
Inorganic Chemistry

FOR DUMMIES®

A Wiley Brand

Learn to:

- **Grasp difficult concepts with ease**
- **Make sense of inorganic and organometallic compounds**
- **Score high in your inorganic chemistry course**



Michael L. Matson
Assistant Professor of Chemistry, University of Houston-Downtown

Alvin W. Orbaek
Rice University, Houston, Texas

Get More and Do More at Dummies.com®

Start with **FREE** Cheat Sheets

Cheat Sheets include

- Checklists
- Charts
- Common Instructions
- And Other Good Stuff!

To access the Cheat Sheet created specifically for this book, go to
www.dummies.com/cheatsheet/inorganicchemistry

Get Smart at Dummies.com

Dummies.com makes your life easier with 1,000s of answers on everything from removing wallpaper to using the latest version of Windows.

Check out our

- Videos
- Illustrated Articles
- Step-by-Step Instructions

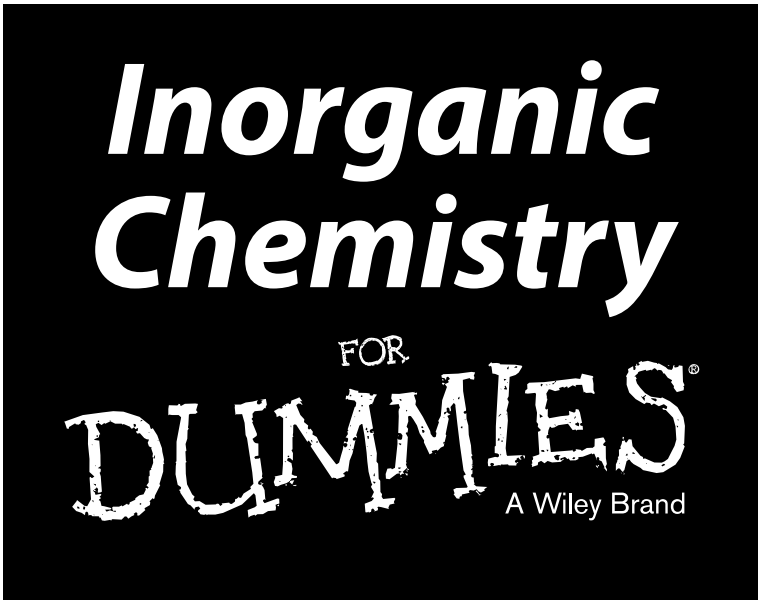
Plus, each month you can win valuable prizes by entering our Dummies.com sweepstakes. *

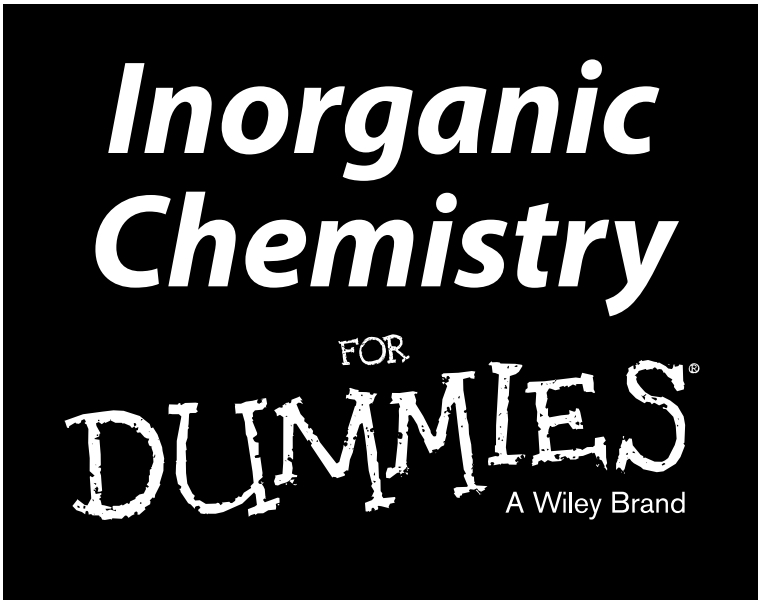
Want a weekly dose of Dummies? Sign up for Newsletters on

- Digital Photography
- Microsoft Windows & Office
- Personal Finance & Investing
- Health & Wellness
- Computing, iPods & Cell Phones
- eBay
- Internet
- Food, Home & Garden

Find out "HOW" at Dummies.com

**Sweepstakes not currently available in all countries; visit Dummies.com for official rules.*


Inorganic
Chemistry
FOR
DUMMIES®
A Wiley Brand



by Michael L. Matson and Alvin W. Orbaek

FOR
DUMMIES®
A Wiley Brand

Inorganic Chemistry For Dummies®
Published by
John Wiley & Sons, Inc.
111 River St.
Hoboken, NJ 07030-5774
www.wiley.com

Published by John Wiley & Sons, Inc., Hoboken, New Jersey

Published simultaneously in Canada

Library of Congress Control Number: 2013932110

ISBN 978-1-118-21794-8 (pbk); ISBN 978-1-118-22882-1 (ebk); ISBN 978-1-118-22891-3 (ebk);
ISBN 978-1-118-22894-4 (ebk)

Manufactured in the United States of America

10 9 8 7 6 5 4 3 2 1

About the Authors

Michael L. Matson started studying chemistry at the U.S. Naval Academy in Annapolis, Maryland. After leaving the Navy, Michael started a PhD program at Rice University, studying the use of carbon nanotubes for medical diagnosis and treatment of cancer. Specifically, Michael focused on internalizing radioactive metal ions within carbon nanotubes: Some radioactive metals could be pictured with special cameras for diagnosis, whereas others were so powerful they could kill cells for treatment. It was at Rice that Michael and Alvin met. Following Rice, Michael went to the University of Houston-Downtown to begin a tenure-track professorship. Happily married to a woman he first met in seventh grade, Michael has two young children, a yellow Labrador retriever named Flounder, is a volunteer firefighter and sommelier, and enjoys CrossFitting.

Alvin W. Orbaek was introduced to chemistry at Rice University (Houston, Texas) by way of nanotechnology, where he studied single-walled carbon nanotubes, transition metal catalysts, and silver nanoparticles. He had previously received a degree in Experimental Physics from N.U.I. Galway (Ireland) and moved into the study of space science and technology at the International Space University (Strasbourg, France). He received a position on Galactic Suite, an orbiting space hotel. To date, he enjoys life by sailing, snowboarding, and DJing. He has been spinning vinyl records since the Atlantic Hotel used to rave, and the sun would set in Ibiza. He hopes to empower people through education and technology, to that effect he is currently completing a PhD in Chemistry at Rice University.

Dedications

Michael: To my wife, Samantha.

Alvin: To Declan, Ann Gitte, Anton, Anna-livia, and Bedstemor.

Authors' Acknowledgments

Michael: I'd like to acknowledge the immeasurable amounts of assistance from Matt Wagner, Susan Hobbs, Lindsay Lefevere, Alecia Spooner, and Joan Freedman.

Alvin: Without John Wiley & Sons, there would be no book, and for that I am very grateful. Particularly because of the very positive and professional attitude by which they carry out their business; thanks for getting it done. It was a blessing to work with you. In particular, I would like to mention Alecia Spooner, Susan Hobbs (Suz), and Lindsay Lefevere, and thanks to the technical editors (Reynaldo Barreto and Bradley Fahlman) for their crucial input. I would also like to thank Matt Wagner for invaluable support and assistance. And to Mike Matson, thank you for the invitation to write this book.

I have had many teachers, mentors, and advisors throughout the years, but there are five who deserve attention. Andrew Smith at Coleenbridge Steiner school, where I enjoyed learning a great deal. John Treacy, who made every science class the most riveting class each day. Pat Sweeney, whose habit of teaching would leave anyone engrossed in mathematics. To Ignasi Casanova for his mentorship and introduction to the nanos. And Andrew Barron, both my PhD advisor and mentor, to whom I owe a great deal of credit, due in no small part to his measure of tutelage.

But all this stands upon a firm foundation that is based on the support of Dec, Gitte, Anton, and Anna; here's to next Christmas — whenever. There are many other friends and family who have contributed to this work, too many to mention them all. But I'd especially like to thank my colleagues from the Irish house, who so graciously agreed to read through the text, namely Alan Taylor, Nigel Alley, and Stuart Corr. Also to Sophia Phounsavath and Brandon Cisneros for proofreading. Jorge Fallas for the Schrödinger equation. To Gordon Tomas for continued support of my writing. And to Gabrielle Novello, who fed me wholesome foods while I otherwise converted coffee and sleepless nights into this book. And to Valhalla for those nights when work was not working for me. And to PHlert, the best sailing program on this planet, or any other.

Publisher's Acknowledgments

We're proud of this book; please send us your comments at http://dummies.custhelp.com. For other comments, please contact our Customer Care Department within the U.S. at 877-762-2974, outside the U.S. at 317-572-3993, or fax 317-572-4002.

Some of the people who helped bring this book to market include the following:

Acquisitions, Editorial, and Media Development

Project Editor: Susan Hobbs

Acquisitions Editor: Lindsay Lefevere

Copy Editor: Susan Hobbs

Assistant Editor: David Lutton

Editorial Program Coordinator: Joe Niesen

Technical Editors: Reynaldo Barreto, Bradley Fahlman

Editorial Manager: Carmen Krikorian

Editorial Assistant: Rachelle Amick

Art Coordinator: Alicia B. South

Cover Photo: © Laguna Design / Science Source

Cartoons: Rich Tennant (www.the5thwave.com)

Composition Services

Project Coordinator: Sheree Montgomery

Layout and Graphics: Carrie A. Cesavice, Joyce Haughey, Brent Savage

Proofreaders: Lindsay Amones, John Greenough, Jessica Kramer

Indexer: BIM Indexing & Proofreading Services

Publishing and Editorial for Consumer Dummies

Kathleen Nebenhaus, Vice President and Executive Publisher

Publishing for Technology Dummies

Andy Cummings, Vice President and Publisher

Composition Services

Debbie Stailey, Director of Composition Services

Contents at a Glance

Introduction 1

Part 1: Reviewing Some General Chemistry 7

Chapter 1: Introducing Inorganic Chemistry 9
Chapter 2: Following the Leader: Atomic Structure and Periodic Trends 21
Chapter 3: The United States of Oxidation 39
Chapter 4: Gone Fission: Nuclear Chemistry 53
Chapter 5: The ABCs: Acid-Base Chemistry 69

Part 11: Rules of Attraction: Chemical Bonding 81

Chapter 6: No Mr. Bond, I Expect You to π: Covalent Bonding 83
Chapter 7: Molecular Symmetry and Group Theory 101
Chapter 8: Ionic and Metallic Bonding 121
Chapter 9: Clinging to Complex Ions: Coordination Complexes 143

Part 111: It's Elemental: Dining at the Periodic Table ... 159

Chapter 10: What the H? Hydrogen! 161
Chapter 11: Earning Your Salt: The Alkali and Alkaline Earth Metals 171
Chapter 12: The Main Groups 183
Chapter 13: Bridging Two Sides of the Periodic Table: The Transition Metals 207
Chapter 14: Finding What Lies Beneath: The Lanthanides and Actinides 221

Part 1V: Special Topics 233

Chapter 15: Not Quite Organic, Not Quite Inorganic: Organometallics 235
Chapter 16: Accelerating Change: Catalysts 253
Chapter 17: Bioinorganic Chemistry: Finding Metals in Living Systems 267
Chapter 18: Living in a Materials World: Solid-State Chemistry 287
Chapter 19: Nanotechnology 305

Part V: The Part of Tens 313
Chapter 20: Ten Nobels 315
Chapter 21: Tools of the Trade: Ten Instrumental Techniques 319
Chapter 22: Ten Experiments 323
Chapter 23: Ten Inorganic Household Products 329
Glossary 335
Index 343

Table of Contents

Introduction 1

About This Book 1
Conventions Used in This Book 2
What You Don't Need to Read 2
Foolish Assumptions 2
How This Book Is Organized 3
Part I: Reviewing Some General Chemistry 3
Part II: Rules of Attraction: Chemical Bonding 4
Part III: It's Elemental: Dining at the Periodic Table 4
Part IV: Special Topics 4
Part V: The Part of Tens 5
Icons Used in This Book 5
Where to Go from Here 6

Part 1: Reviewing Some General Chemistry 7

Chapter 1: Introducing Inorganic Chemistry 9

Building the Foundation 9
Losing your electrons 10
Splitting atoms: Nuclear chemistry 11
Changing pH 12
Getting a Grip on Chemical Bonding 12
Traveling Across the Periodic Table 13
Hyping up hydrogen 14
Moving through the main groups 15
Transitioning from one side of the table to another 15
Uncovering lanthanides and actinides 16
Diving Deeper: Special Topics 16
Bonding with carbon: Organometallics 17
Speeding things up: Catalysts 17
Inside and out: Bio-inorganic and environmental chemistry 17
Solid-state chemistry 18
Nanotechnology 19
Listing 40 More 19

Chapter 2: Following the Leader: Atomic Structure and Periodic Trends. 21

Up an' Atom: Reviewing Atomic Terminology 22
Sizing up subatomic particles 25
Knowing the nucleus 26
Going orbital 26
Distinguishing atomic number and mass number 30
Identifying isotopes 31
Grouping Elements in the Periodic Table 32
Keeping up with periodic trends 33
Measuring atomic size 35
Rating the atomic radius 36
Eyeing ionization energy 36
Examining electron affinities 38
Noting electronegativity 38

Chapter 3: The United States of Oxidation. 39

Entering the Oxidation-Reduction Zone 39
Following oxidation state rules 41
Scouting reduction potentials 43
Walking through a Redox Reaction 46
Isolating Elements 48
Mechanically separating elements 48
Using thermal decomposition 50
Displacing one element with another 50
Heating things up: High-temperature chemical reactions 50
Relying on electrolytic reduction 51

Chapter 4: Gone Fission: Nuclear Chemistry. 53

Noting Nuclear Properties 53
Using the force 54
The empirical strikes back 55
Documenting Atomic Decay: Radioactivity 58
Alpha radiation 60
Beta radiation 60
Gamma radiation 62
The half-life principle 62
Blind (radiocarbon) dating 63
Radioisotopes 64
Catalyzing a Nuclear Reaction 65
Fission 66
Fusion 67

Chapter 5: The ABCs: Acid-Base Chemistry 69

Starting with the Basics: Acids and Bases 70
Developing the pH Scale 70
Calculating pH 71
Calculating acid dissociation 72
Touring Key Theories: A Historical Perspective 72
The early years 72
Brønsted-Lowry theory 73
Accepting or donating: Lewis's theory 75
Comparing Lewis and Brønsted theories 76
Pearson's Hard and Soft Acids and Bases (HSAB) 77
Characterization of the hard bodies 78
Who you callin' soft? 78
Strapping on a Cape: Superacids 79

Part II: Rules of Attraction: Chemical Bonding 81

Chapter 6: No Mr. Bond, I Expect You to π: Covalent Bonding 83

Connecting the Dots: Lewis Structures 83
Counting electrons 84
Placing electrons 86
Price tags in black ties? Formal charges 87
Returning to the drawing board: Resonance structures 89
Keeping Your Distance: VSEPR 90
Ante Up One Electron: Valence-Bond Theory 92
Summing It All Up: Molecular Orbital Theory 94
Types of MOs 94
Evens and odds: Gerade and ungerade symmetry 95
Identical twins: Homonuclear diatomic molecules 96
Fraternal twins: Heteronuclear diatomic molecules 99

Chapter 7: Molecular Symmetry and Group Theory. 101

Identifying Molecules: Symmetry Elements and Operations 101
Identity 102
n-fold rotational axis 103
Inversion center 104
Mirror planes 104
Improper rotation axis 105
It's Not Polite to Point! Molecular Point Groups 107

Being Such a Character Table 110
Dissecting a character table 110
Degrees of freedom 113
A glitch in the matrix: Matrix math 114
Reducible reps 117
Infrared and Raman active modes 120

Chapter 8: Ionic and Metallic Bonding 121

Blame It on Electrostatic Attraction: Forming Ionic Bonds 121
Marrying a cation and an anion 122
Measuring bond strength: Lattice energy 123
Coexisting with covalent bonds 125
Conducting electricity in solution 127
Admiring Ionic Crystals 128
Studying shapes: Lattice types 128
Size matters (when it's ionic) 130
"I'm Melting!" Dissolving Ionic Compounds with Water: Solubility 131
Just add water: Hydrated ions 132
Counting soluble compounds 134
What Is a Metal, Anyway? 134
Tracing the history of metallurgy 135
Admiring the properties of solid metals 135
Delocalizing electrons: Conductivity 137
Analyzing alloys 137
Swimming in the Electron Sea: Metallic Bonding Theories 139
Free-electron theory 140
Valence bond theory 141
Band theory 142

Chapter 9: Clinging to Complex Ions: Coordination Complexes 143

Counting bonds 144
Seeking stability 144
Grouping geometries 146
Identifying Isomers 147
Connecting differently: Structural isomers 148
Arranged differently: Stereoisomers 148
Naming Coordination Complexes 151
Sorting Out the Salts 154
Creating Metal Complexes throughout the Periodic Table 155
Alkali metals 155
Alkali earth metals 155
Transition metals 156
Lanthanides and actinides 157
Metalloids 157
Applying Coordination Complexes in the Real World 158

Part III: It's Elemental: Dining at the Periodic Table ... 159

Chapter 10: What the H? Hydrogen! 161

Visiting Hydrogen at Home: Its Place in the Periodic Table 161
Appreciating the Merits of Hydrogen 164
Available in abundance 164
Molecular properties 164
Nuclear spin 165
Introducing Hydrogen Isotopes 165
Investing in Hydrogen Bonds 166
Forming a hydrogen ion 166
Creating hydrides 166
Applying Itself: Hydrogen's Uses in Chemistry and Industry 168

Chapter 11: Earning Your Salt: The Alkali and Alkaline Earth Metals 171

Salting the Earth: Group 1 Elements 172
Lithium the outlier 173
Seafaring sodium 174
Maintaining your brain with potassium 175
Rubidium, cesium, francium, oh my 176
Reacting Less Violently: The Group 2 Alkaline Earth Metals 176
Being beryllium 178
Magnificent magnesium 178
Commonly calcium 179
Strontium, barium, radium 180
Diagramming the Diagonal Relationship 181

Chapter 12: The Main Groups 183

Placing Main Group Elements on the Periodic Table 184
Lucky 13: The Boron Group 185
Not-so-boring boron 185
An abundance of aluminum 187
Mendeleev's Missing Link: Gallium 187
Increasing indium use 188
Toxic thallium 189
The Diamond Club: The Carbon Group 189
Captivating carbon 190
Coming in second: Silicon 191
Germane germanium 192
Malleable tin cans 192
Plumbing lead 193
Noting Pnictides of the Nitrogen Group 193
Leading the pnictides: nitrogen 194
Finding phosphorus everywhere 195
Melding the metalloids: Arsenic and antimony 195

Keeping Up with the Chalcogens 196
Oxygen all around 196
Sulfur 197
From the Earth to the moon 198
Marco — polonium! 199
(Re)Active Singles: The Group 17 Halogens 199
Cleaning up with chlorine 201
Briny bromine 201
Iodine 202
Rarely astatine 203
Lights of New York: The Group 18 Noble Gases 203

Chapter 13: Bridging Two Sides of the Periodic Table: The Transition Metals 207

Getting to Know Transition Metals 208
Sorting T-metals into series 208
Separating T-metals from the main group 209
Partially Filling d-Orbitals 209
Calculating an effective nuclear charge 210
Forming more than one oxidation state 210
Splitting the Difference: Crystal Field Theory and Transition Metal Complexes 212
Dividing d-orbitals 213
Absorbing light waves: Color 215
Building attraction: Magnetism 216
Electronic Structure and Bonding 218
Reacting with other elements 218
Creating coordination complexes 220
Adsorbing gas: T-metals in catalysis 220

Chapter 14: Finding What Lies Beneath: The Lanthanides and Actinides 221

Spending Quality Time with the Rare Earth Elements: Lanthanides 222
Electronic structure 222
Reactivity 223
Lanthanide contraction 224
Separating the lanthanide elements 225
Using lanthanides 227
Feelin' Radioactive: The Actinides 227
Finding or making actinides 228
Examining electronic structure 228
Comparing Reactivity: Actinide versus Lanthanide 230
Looking More Closely at Uranium 230

Part IV: Special Topics..... 233

Chapter 15: Not Quite Organic, Not Quite Inorganic: Organometallics 235

Building Organometallic Complexes 235
Adhering to Electron Rules 236
Counting to eight: The octet rule 237
Calculating with the 18-electron rule 237
Settling for 16 electrons 239
Effectively using the EAN rule 239
Bonding with Metals: Ligands 240
Including Carbon: Carbonyls 241
Providing the Best Examples 242
e-precise carbon 242
e-rich nitrogen 243
e- deficient boron 243
Behaving Oddly: Organometallics of Groups 1, 2, and 12 245
Sandwiched Together: Metallocenes 246
Clustering Together: Metal-Metal Bonding 247
Creating Vacancies: Insertion and Elimination 248
Synthesizing Organometallics 249
Showing Similarities with Main Group Chemistry 251

Chapter 16: Accelerating Change: Catalysts 253

Speeding Things Up — The Job of a Catalyst 253
Considering Types of Catalysts 256
Homogenous catalysts 256
Heterogeneous 260
Organocatalysts 263

Chapter 17: Bioinorganic Chemistry: Finding Metals in Living Systems 267

Focusing on Photosynthesis 268
Climbing Aboard the Oxygen Transport 270
Feeding a Nitrogen Fixation 271
Fixing nitrogen for use by organisms 272
Re-absorbing nitrogen 273
Being Human 274
Making things happen: Enzymes 275
Curing disease: Medicines 277
Causing problems: Toxicity 278

Answering When Nature Calls: Environmental Chemistry 279
Eyeing key indicators 280
Rocking the heavy metals 282
Killing me softly: Pesticides 283
Looking for and removing contaminants 284

Chapter 18: Living in a Materials World: Solid-State Chemistry. . . .287

Studying Solid Structures 287
Building crystals with unit cells 288
Labeling lines and corners: Miller indices 290
Three Types of Crystal Structure 291
Simple crystal structures 291
Binary crystal structures 292
Complex crystal structures 293
Calculating Crystal Formation: The Born-Haber Cycle 294
Bonding and Other Characteristics 296
Characterizing size 297
Dissolving in liquids: Solubility 298
Encountering zero resistance: Superconductivity 300
Information technology: Semiconductors 301
Synthesizing Solid Structures 302
Detecting Crystal Defects 303

Chapter 19: Nanotechnology 305

Defining nanotechnology 305
History of nanotechnology 306
The science of nanotechnology 307
Top-down versus bottom-up 307
Nanomaterials 308
Size and shape control 308
Self-assembly and gray goo 309
Applications for Nanotechnology 310
Cancer therapy 310
Catalysis 311
Education 312

Part V: The Part of Tens..... 313

Chapter 20: Ten Nobels 315

Locating Ligands: Alfred Werner 315
Making Ammonia: Fritz Haber 316
Creating Transuranium Elements: McMillan and Seaborg 316
Adding Electronegativity: Pauling 316
Preparing Plastics: Ziegler and Natta 317
Sandwiching Compounds: Fischer and Wilkinson 317

Illuminating Boron Bonds: Lipscomb....317
Characterizing Crystal Structures: Hauptman and Karle....318
Creating Cryptands: Jean-Marie Lehn....318
Making Buckyballs....318

Chapter 21: Tools of the Trade: Ten Instrumental Techniques....319

Absorbing and Transmitting Light Waves: UV-vis and IR....319
Catching Diffracted Light: XRD....320
Rearranging Excited Atoms: XRF....320
Measuring Atoms in Solution: ICP/AA....320
Detecting Secondary Electrons: SEM....321
Reading the Criss-Crossed Lines: TEM....321
Characterizing Surface Chemistry: XPS....321
Evaporating Materials: TGA....322
Cyclic Voltammetry....322
Tracking Electron Spin: EPR....322

Chapter 22: Ten Experiments....323

Turning Blue: The Clock Reaction....323
Forming Carbon Dioxide....324
The Presence of Carbon Dioxide....324
Mimicking Solubility....324
Separating Water into Gas....325
Testing Conductivity of Electrolyte Solutions....325
Lemon Batteries....326
Purifying Hydrogen....326
Colorful Flames....326
Making Gunpowder....327

Chapter 23: Ten Inorganic Household Products....329

Salting Your Food....329
Bubbling with Hydrogen Peroxide....330
Baking with Bicarbonate....330
Whitening with Bleach....331
Using Ammonia in Many Ways....331
Killing Pests with Borax....332
Soothing Babies with Talc....332
Cleaning with Lye....333
Scratching Stainless Steel....333
Wrapping It Up with Aluminum Foil....334

Glossary....335

Index....343

Introduction

Inorganic chemistry deals with all the atoms on the periodic table, the various rules that govern how they look, and how they interact. At first glance, trying to understand the differences among 112 atoms might seem like a mammoth task. But because of the periodic table, we can bunch them up into groups and periods and make them much easier to grasp.

So welcome to *Inorganic Chemistry For Dummies*. We hope that through this book you come to learn a great deal about the environment around you, what materials you use on a regular basis, and why some materials are more important to us than others. This book is fun and informative, while at the same time insightful and descriptive. And it's designed to make this fascinating and practical science accessible to anyone, from the novice chemist to the mad scientist.

About This Book

This book was written in such a way that you can start in any chapter you choose, in the chapter that interests you the most, without having to read all the chapters before it. But the chapters build on material from one chapter to the next, so if you feel more background would help you, feel free to start with Chapter 1. You can also make use of the numerous cross references in each chapter to find pertinent information. But it can also be read like a study guide to help a student understand some of the more complicated aspect of this fascinating science.

We tried to make the information as accessible as possible. Each chapter is broken down into bite-sized chunks that make it easy for you to quickly digest and understand the material presented. Some of the chunks are further broken down into subsections when there's special need to elaborate further on the concepts being discussed.

Science is a process that requires lots of imagination. It requires more imagination than memory, especially as you start to learn more and more about a certain topic. To help with your imagination we have tried to include helpful graphics and artwork that complement the writing within the text. Further to this we include many real-world examples and interesting historical or scientific tidbits to keep your curiosity piqued.

Conventions Used in This Book

Science progressed more rapidly in the last 200 years than it had in the few thousand years previous. A great deal of this success came from the agreement among scientist to create and use a set of standard conventions. The two most important conventions are the periodic table and the international system of units, called SI units. SI units are based on the metric system, and it's more common to see temperature expressed as Celsius than Fahrenheit. And you see lengths expressed in meters instead of inches and feet. Weights and mass are expressed in terms of grams instead of pounds or stone.

And the following conventions throughout this text make everything consistent and easy to understand:

- All Web addresses appear in `monofont`.
- New and key terms appear in *italics* and are closely followed by an easy-to-understand definition.
- **Bold** text highlights the action part of numbered steps.

What You Don't Need to Read

Sidebars are highlighted in gray-shaded boxes so they're easy to pick out. They contain fun facts and curious asides, but none of their information is crucial to your understanding of inorganic chemistry. Feel free to just skip over them if you prefer.

Foolish Assumptions

As authors of *Inorganic Chemistry For Dummies* we may have made a few foolish assumptions about the readership. We assume that you have very little background in chemistry, and possibly none at all; that you're new to inorganic chemistry, and maybe you have never heard of the subject before. We assume that you know what chemistry is, but not much more than that. This book begins with all the general chemistry info that you need to grasp the concepts and material in the rest of the book. If you have some understanding of general chemistry, however, all the better.

You may be a medical student who needs to brush up in inorganic chemistry, or a high school student getting ready for a science fair, or even a freshman or junior at college. We've tailored this book to meet all your needs, and we

sincerely hope you find great explanations about the concepts presented that are also engaging, interesting, and useful.

When you finish reading this book and your interest in chemistry is heightened, we recommend that you go to a local bookseller (second-hand book stores are a personal favorite) and find more books that offer other perspectives on inorganic chemistry. There are also excellent resources on the Internet, and many schools make class notes available online. But the best way to get involved in chemistry is by doing it. Chemistry is a fun and exciting field, made evident when you conduct chemistry experiments. Keep an eye out for demonstration kits that enable you to do your own experiments at home. And note that the last chapter of this book offers ten really cool experiments, too.

How This Book Is Organized

This book is organized into multiple parts that group topics together in the most logical way possible. Here's a brief description of each section of *Inorganic Chemistry For Dummies*:

Part 1: Reviewing Some General Chemistry

Here you are introduced to science in general, and we give you the basic tenets of general chemistry that help you throughout the rest of the book.

In Chapter 1, you start with an introduction to inorganic chemistry, what it is, and why it is important. You learn how it's different from organic chemistry and how this difference is important for technology and society.

The following chapters of this section deal with topics that are covered in many general chemistry textbooks, but these chapters cover the topics in greater detail than a general chemistry textbook. In Chapter 2 we explain what the atom looks like, how it's structured, and why this is important for inorganic chemistry. In particular, this chapter delves into the periodic table and how the structure of the atom is described. Chapter 3 introduces oxidation and reduction chemistry that helps you understand why many chemical reactions take place. It deals with the electrons that each atom has and how the electrons can be shuttled around from atom to atom. Then in Chapter 4 we focus on the nucleus and how changes to the nucleus lead to nuclear chemistry. And finally we end this section by talking about acid-base chemistry because this can help you understand the many ways in which atoms and molecules interact with one another.

Part II: Rules of Attraction: Chemical Bonding

In this section we talk about the various ways that atoms can bond with one another. In Chapter 6 we introduce covalent bonding. Chapter 7 deals with molecular symmetry, not just for inorganic chemistry but also fundamental to many of the physical sciences. Ionic and metallic bonding are detailed in Chapter 8.

Chapter 9, like all of the chapters, can be read as a standalone chapter, but it's much easier to understand if you read through the three preceding chapters. If you get stuck on coordination complexes, however, refer back to the previous three chapters for a little background information.

Part III: It's Elemental: Dining at the Periodic Table

The periodic table contains over 100 separate and unique elements, which are described in Part III. We cover all the important elements; and to make it easier to digest, we've broken them down into five related chapters. Each chapters deals with elements that are similar to each other, making them easier to understand.

To get the ball rolling we introduce hydrogen in Chapter 10, because it's the most abundant element in the universe and can be found in many chemicals and materials. We then move from left to right on the periodic table, starting off with the alkali and alkali earth elements in Chapter 11. We guide you through the periodic table to the main group elements in Chapter 12, the transition metals in Chapter 13, and finally round out Part III with the lanthanides and actinides in Chapter 14.

Part IV: Special Topics

These chapters cover what makes the study of inorganic chemistry so interesting and also distinguishes it from organic chemistry. However, you will find a great deal of overlap with other fields of study such as material science, physics, and biology.

Inorganic chemistry became a modern science with the advent of organometallic chemistry, described in Chapter 15. Chapter 16 shows you how

practical and important catalysis is to the modern world in which we live. Chapter 17 deals with the inorganic chemistry of living systems and the environment. The subject matter makes this chapter unique from the others in this section. This is also true for Chapter 18 where we describe solid state chemistry, the basis of the information technology revolution. Chapter 19 gives you a quick introduction to one of the most interesting and promising technological developments of the modern age, namely nanotechnology.

Part V: The Part of Tens

To make this book even easier to grasp and read, we compiled three important lists to help you in your study of inorganic chemistry. In Chapter 20, we introduce and explain ten common household products. Then, in Chapter 21, you meet ten of the most important Nobel Prizes that were awarded to chemists. Chapter 22 introduces ten instruments and techniques that are commonly found and used in laboratories across the globe. And finally we give you ten experiments that you can try out at home in Chapter 23. Remember, one of the most fun parts of chemistry is doing chemistry, and this chapter gives you some fun experiments to try.

Icons Used in This Book

Throughout this book icons are used to draw your attention to certain information.

This is not often used here, but the Tip icon indicates that some information may be especially useful to you.

When you see the Remember icon you should understand that this information is quite important to understanding the concepts being explained. If you are studying inorganic chemistry, this is one of the most important icons to look for. It can indicate a definition, or be a concise explanation of a concept; at other times it indicates information to help you grasp how various concepts overlap.

The Warning icon tells you to pay close attention to what's being said because it indicates where a potentially dangerous situation may arise.

The Technical Stuff icon is used to indicate detailed information; for some people, it might not be necessary to read or understand.

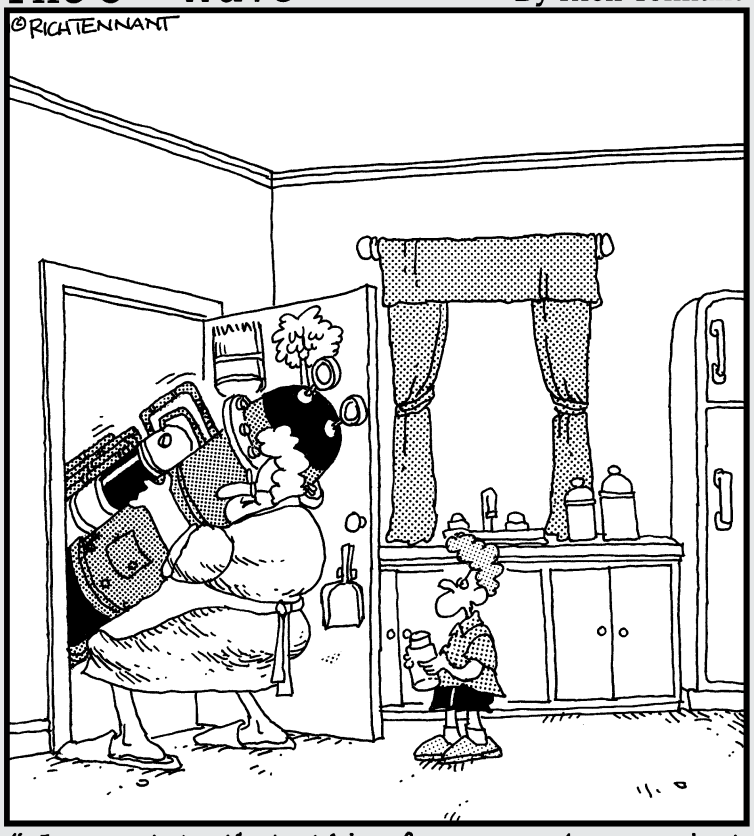
Where to Go from Here

You might be taking an inorganic chemistry course, or maybe you're just curious about the world around you. Regardless, if you're looking for something specific, you can find it by checking the index or maybe even the glossary. When you know where to find what you are looking for, go right ahead and jump in. And enjoy.

Part I

Reviewing Some General Chemistry

The 5th Wave By Rich Tennant



"You can take that old jar for your science project, I'm sure I have some baking soda you can borrow, and let's see, where's that old particle accelerator of mine... here it is in the pantry."

In this part . . .

You navigate through some of the basic rules of the road that help guide you as you travel through the science of inorganic chemistry. This starts with a definition of inorganic chemistry and continues with a description of the foundation upon which this subject stands. Inorganic chemistry is the study of all the materials known to humankind, and it includes the study of how all the materials interact with one another.