

Contents

Chapter 1 Nuclear Magnetic Resonance Spectroscopy	1
<i>By B. E. Mann</i>	
1 Introduction	1
2 Stereochemistry	4
Complexes of Li, Be, Mg, Ca, Sc, Y, La, Ce, Er, and U	4
Complexes of Ti, Zr, Hf, V, Nb, and Ta	7
Complexes of Cr, Mo, and W	10
Complexes of Mn and Re	19
Complexes of Fe, Ru, and Os	22
Complexes of Co, Rh, and Ir	34
Complexes of Ni, Pd, and Pt	42
Complexes of Cu, Ag, and Au	56
Complexes of Zn, Cd, and Hg	57
3 Dynamic Systems	61
Fluxional Molecules	61
Equilibria	72
Solvation Studies of Ions	72
Ionic Equilibria	76
Equilibria among Uncharged Species	80
Course of Reactions	84
4 Paramagnetic Complexes	88
Compounds of <i>d</i> -Block Transition Elements	89
Compounds of the Lanthanides and Actinides	95
5 N.M.R. Spectra of Biological Systems containing Metals	100
6 Solid-state N.M.R. Spectroscopy	105
Motions in Solids	107
Structure of Solids	112
7 Group III Compounds	120
Boron Hydrides and Carbaboranes	120
Other Compounds of Boron	134
Complexes of other Group III Elements	136

8	Compounds of Silicon, Germanium, Tin, and Lead	138
9	Compounds of Group V Elements	154
10	Compounds of Groups VI and VII, Helium, and Xenon	162
<hr/>		
Chapter 2	Nuclear Quadrupole Resonance Spectroscopy	167
	<i>By J. H. Carpenter</i>	
1	1 Introduction	167
1	2 Instrumentation and Techniques	167
4	3 Main Group Elements	169
4	Group II (Barium-135 and Barium-137)	169
7	Group III (Aluminium-27, Gallium-69, and Indium-115)	169
10	Group V (Nitrogen-14, Arsenic-75, Antimony-121, Antimony-123, and Bismuth-209)	170
10	Group VI (Oxygen-17)	173
22	Group VII (Chlorine-35, Chlorine-37, Bromine-79, Bromine-81, and Iodine-127)	174
34	4 Transition Metals	184
42	Manganese-55	184
42	Copper-63 and Copper-65	185
56	Niobium-93 and Tantalum-181	185
56	Rhenium-185 and Rhenium-187	185
57	Mercury-201	187
61	Chapter 3 Microwave Spectroscopy	188
61	<i>By J. H. Carpenter</i>	
72	1 Introduction	188
72	2 Instrumentation and Techniques	189
76	3 Diatomic Molecules	191
80	4 Triatomic Molecules	195
84	5 Tetra-atomic Molecules	198
88	6 Penta-atomic Molecules	199
89	7 Molecules containing Six or More Atoms	202
92		

Chapter 4 Vibrational Spectra of Small Symmetric Species and of Single Crystals

By *D. M. Adams*

1 General Introduction	208
2 Spectra of Small Symmetric Species	210
Diatomic Species	210
Triatomic Species	211
Tetra-atomic Species	217
Penta-atomic Species	219
Hexa-atomic Species	224
Hepta-atomic Species	226
Larger Symmetric Species	229
3 Single-crystal and Other Solid-state Spectroscopy	232
Introduction	233
'Simple' Lattice Types	233
Mixed Oxides and Fluorides	236
Sheet and Chain Structures	239
Oxoanionic Crystals	241
Silicates	243
Complex Cationic Salts	244
Complex Anionic Salts	245
Molecular Crystals	252
Chapter 5 Characteristic Vibrational Frequencies of Compounds containing Main-group Elements	255
By <i>S. R. Stobart</i>	
1 Group I Elements	255
2 Group II Elements	255
3 Group III Elements	257
Compounds containing B—H Bonds	257
Compounds containing Al—H or Ga—H Bonds	263
Compounds containing B—In Bonds	264
Compounds containing M—C Bonds (M = B, Al, Ga, In, or Tl)	264
Compounds containing M—N Bonds (M = B, Al, Ga, or In)	265
Compounds containing B—P or B—As Bonds	268
Compounds containing M—O Bonds (M = B, Al, Ga, In, or Tl)	268
Compounds containing M—S Bonds (M = B, Ga, In, or Tl)	270

Compounds containing M—Halogen Bonds (M = B, Al, Ga, or In)	271
4 Group IV Elements	274
Compounds containing M—H Bonds (M = Si, Ge, or Sn)	274
Compounds containing M—C Bonds (M = Si, Ge, or Sn)	278
Compounds containing Si—Si Bonds	280
Compounds containing M—N Bonds (M = Si, Ge, Sn, or Pb)	281
Compounds containing M—P (M = Si, Ge, or Sn) or M—As or M—Sb Bonds (M = Ge or Sn)	284
Compounds containing M—O Bonds (M = Si, Ge, Sn, or Pb)	285
Compounds containing M—S or M—Se Bonds (M = Si, Ge, Sn, or Pb)	288
Compounds containing M—Halogen Bonds (M = Si, Ge, Sn, or Pb)	290
5 Group V Elements	291
Compounds containing E—H Bonds (E = N, P, or As)	291
Compounds containing E—C Bonds (E = N, P, As, Sb, or Bi)	293
Compounds containing N—N or N—P Bonds	295
Compounds containing N—E Bonds (E = As, Sb, or Bi) or P—P or As—As Bonds	299
Compounds containing E—O Bonds (E = N, P, As, Sb, or Bi)	302
Compounds containing N—S or P—S Bonds	305
Other Compounds containing a Group V Element Bonded to a Group VI Element	307
Compounds containing Group V—Halogen Bonds	308
6 Group VI Elements	310
Compounds containing O—H or S—H Bonds	310
Compounds containing E—C Bonds (E = S, Se, or Te)	311
Compounds containing O—O, S—O, Se—O, Te—O, S—S, or Te—S Bonds	311
Compounds containing Group VI—Halogen Bonds	315
7 Group VII Elements	316
8 Group VIII Elements	317

Chapter 6	Vibrational Spectra of Transition-element Compounds	320
	By <i>M. Goldstein</i>	
1	Introduction	320
2	General	320
3	Scandium and Yttrium	328
4	Titanium, Zirconium, and Hafnium	329
5	Vanadium, Niobium, and Tantalum	333
6	Chromium, Molybdenum, and Tungsten	338
7	Manganese, Technetium, and Rhenium	344
8	Iron, Ruthenium, and Osmium	346
9	Cobalt, Rhodium, and Iridium	351
10	Nickel, Palladium, and Platinum	356
11	Copper, Silver, and Gold	366
12	Zinc, Cadmium, and Mercury	369
13	Lanthanides	371
14	Actinides	372
Chapter 7	Vibrational Spectra of Some Co-ordinated Ligands	377
	By <i>G. Davidson</i>	
1	Carbon Donors	377
2	Boron Donors	400
3	Carbonyl and Thiocarbonyl Complexes	402
4	Nitrogen Donors	413
	Molecular Nitrogen, Azido, and Related Species	413
	Amines and Related Ligands	417
	Oximes	426

Ligands containing C=N Groups	428
Cyanides and Isocyanides	433
Nitrosyls	438
5 Phosphorus and Arsenic Donors	441
6 Oxygen Donors	444
Molecular Oxygen, Peroxo-, and Hydroxy-complexes	444
Acetylacetonates and Related Complexes	447
Carbonato-complexes	449
Carboxylato-complexes	450
Keto, Alkoxy, Phenoxy, and Ether Ligands	457
O-Bonded Amides and Ureas	460
Nitrates and Nitrate-complexes	461
Ligands containing O—N, O—P, or O—As Bonds	464
Ligands containing O—S or O—Se Bonds	467
7 Sulphur and Selenium Donors	470
8 Potentially Ambidentate Ligands	477
Cyanate and Thiocyanate Complexes and their Iso-analogues	477
Ligands containing N and O or P and O Donor Atoms	481
Ligands containing N and As or N and S Donor Atoms	491
Ligands containing O and S Donor Atoms	493
9 Appendix: Additional References to Metal Carbonyl Complexes	496
Chromium Carbonyl Complexes	496
Molybdenum Carbonyl Complexes	500
Tungsten Carbonyl Complexes	503
Manganese Carbonyl Complexes	505
Rhenium Carbonyl Complexes	507
Iron Carbonyl Complexes	508
Ruthenium Carbonyl Complexes	515
Osmium Carbonyl Complexes	516
Cobalt Carbonyl Complexes	517
Rhodium Carbonyl Complexes	519
Iridium Carbonyl Complexes	519
Nickel, Palladium, Platinum, and Copper Carbonyl Complexes	520
Mixed-metal Carbonyl Complexes	520

Chapter 8 Mössbauer Spectroscopy	522
By R. Greatrex	
1 Introduction	522
Books and Reviews	523
2 Theoretical	525
3 Instrumentation and Methodology	529
4 Iron-57	533
General Topics	533
Nuclear Parameters and Isomer Shift Calibrations	535
Pressure-dependence Studies	536
Diffusion Studies	537
Alloy-type Systems	539
Frozen Solutions and Liquid Crystals	542
^{57}Fe Impurity Studies	545
^{57}Co Source Experiments and Decay After-effect Phenomena	552
Compounds of Iron	556
High-spin Iron(II) Compounds	556
High-spin Iron(III) Compounds	563
Spin- and Orbital-crossover Systems, Unusual Electronic States, and Biological Molecules	571
Low-spin and Covalent Complexes	576
Oxide and Chalcogenide Systems containing Iron	586
Binary Oxides	586
Spinel Oxides	589
Garnet Oxides	593
Perovskite Oxides	595
Other Oxides	598
Mineral Oxides	599
Chalcogenides	601
5 Tin-119	603
General Topics	603
Nuclear Parameters	604
^{119}Sn Impurity Studies	605
Tin(II) Compounds	607
Tin(IV) Compounds	609
Oxide and Chalcogenide Systems containing Tin	617
Oxides	617
Chalcogenides	619

6 Other Elements	621
Main Group Elements	621
Germanium (^{73}Ge)	621
Krypton (^{83}Kr)	621
Antimony (^{121}Sb)	621
Tellurium (^{125}Te)	624
Iodine (^{127}I , ^{129}I)	626
Transition Elements	629
Nickel (^{61}Ni)	629
Zinc (^{67}Zn)	629
Technetium (^{99}Tc)	629
Ruthenium (^{99}Ru , ^{101}Ru)	629
Hafnium (^{178}Hf , ^{180}Hf)	633
Tantalum (^{181}Ta)	633
Tungsten (^{180}W , ^{182}W , ^{183}W , ^{184}W , ^{186}W)	636
Iridium (^{193}Ir)	636
Platinum (^{195}Pt)	637
Gold (^{197}Au)	638
Lanthanide and Actinide Elements	640
Lanthanum (^{139}La)	640
Praseodymium (^{141}Pr)	641
Europium (^{151}Eu , ^{153}Eu)	641
Gadolinium (^{155}Gd)	647
Dysprosium (^{161}Dy)	647
Erbium (^{166}Er)	650
Ytterbium (^{170}Yb , ^{172}Yb , ^{174}Yb , ^{176}Yb)	650
Thorium (^{232}Th)	651
Neptunium (^{237}Np)	651
7 Bibliography	652
Author Index	657