

Contents of further subvolumes of III/27

Magnetic properties of non-metallic inorganic compounds based on transition elements

Subvolume A: Pnictides and chalcogenides I

1	Magnetic properties of pnictides and chalcogenides	1
1.1	Pnictides and chalcogenides based on 3d transition elements (K. ADACHI, S. OGAWA)	1
1.1.1	Introduction	1
1.1.1.1	General remarks	1
1.1.1.2	List of frequently used symbols and abbreviations	1
1.1.2	Compounds with pyrite, marcasite and arsenopyrite structures	7
1.1.2.1	MX_2 compounds with pyrite (FeS_2) type structure	8
1.1.2.1.1	MnX_2 ($X=S, Se, Te$)	15
1.1.2.1.2	FeX_2 ($X=S, Se, Te$)	18
1.1.2.1.3	CoX_2 ($X=S, Se, Te$)	20
1.1.2.1.4	NiX_2 ($X=S, Se, Te$)	28
1.1.2.1.5	CuX_2 ($X=S, Se, Te$)	33
1.1.2.1.6	ZnX_2 ($X=S, Se$)	36
1.1.2.2	$M_xM'_{1-x}X_2$ mixed systems with pyrite (C2) type structure	37
1.1.2.2.1	$Cr_xCo_{1-x}S_2$	37
1.1.2.2.2	$Mn_xM'_{1-x}X_2$ ($M'=Fe, Mg, Cu, Zn; X=S, Se, Te$)	37
1.1.2.2.3	$Fe_{1-x}M'_xS_2$ ($M'=Co, Ni$)	41
1.1.2.2.4	$Co_{1-x}Ni_xS_2$	45
1.1.2.2.5	$Ni_{1-x}Cu_xS_2$	46
1.1.2.3	$MS_{2-x}Se_x$ mixed systems with pyrite (C2) type structure	47
1.1.2.3.1	$CoS_{2-x}Se_x$	47
1.1.2.3.2	$NiS_{2-x}Se_x$	52
1.1.2.4	MY_xX_{2-x} and $M_{1-x}M'_xYX$ mixed systems with cobaltite or pyrite (C2) type structure	54
1.1.2.4.1	CoP_xS_{2-x}	55
1.1.2.4.2	$CoAs_xS_{2-x}$	56
1.1.2.4.3	$NiPS$	57
1.1.2.4.4	$NiAs_xS_{2-x}$	58
1.1.2.4.5	$Co_{1-x}Ni_xAsS$	58
1.1.2.5	$MX_2, MY_2, M_xM'_{1-x}Y_2$ and $MY_{2-x}X_x$ compounds with marcasite (C18) type structure	59
1.1.2.5.1	$CrSb_2$	60
1.1.2.5.2	FeP_2	61
1.1.2.5.3	$FeAs_2$	61
1.1.2.5.4	$FeSb_2$	61
1.1.2.5.5	$CoSb_2$	62
1.1.2.5.6	$CoTe_2$	63
1.1.2.5.7	$NiAs_2$ (β - $NiAs_2$)	63
1.1.2.5.8	$NiSb_2$	63

1.1.2.5.9	$M_{1-x}M'_xY_2$ (M, M'=Cr, Fe, Ni; Y=As, Sb)	64
1.1.2.5.10	$FeAs_{2-x}Se_x$	64
1.1.2.6	MY_xX_{2-x} and MY_2 compounds with arsenopyrite (E0 ₇) type structure	64
1.1.2.6.1	$FeSb_xTe_{2-x}$	64
1.1.2.6.2	CoP_2	64
1.1.2.6.3	$CoAs_2$	65
1.1.2.6.4	$CoSb_2$	65
1.1.2.7	References for 1.1.2	65
1.1.3	Compounds with NiAs and MnP structures	70
1.1.3.1	$M_{1-x}X$ chalcogenides with NiAs type structure and their mixed systems	70
1.1.3.1.1	$Ti_{1-x}X$ (X=S, Se, Te)	81
1.1.3.1.2	$V_{1-x}X$ (X=S, Se, Te)	81
1.1.3.1.3	$Cr_{1-x}X$ (X=S, Se, Te)	83
1.1.3.1.4	MnX (X=S, Se, Te)	88
1.1.3.1.5	$Fe_{1-x}X$ (X=S, Se, Te)	89
1.1.3.1.6	$Co_{1-x}X$ (X=S, Se, Te)	92
1.1.3.1.7	$Ni_{1-x}X$ (X=S, Se, Te)	93
1.1.3.1.8	References for 1.1.3.1	140
1.1.3.2	MY pnictides with MnP and NiAs type structures and their mixed systems	148
1.1.3.2.1	MP (M=V, Cr, Mn, Fe)	159
1.1.3.2.2	MAs (M=Ti, V, Cr, Mn, Fe, Co, Ni)	163
1.1.3.2.3	MSb (M=Ti, V, Cr, Mn, Fe, Co, Ni)	170
1.1.3.2.4	MBi (M=Mn, Ni)	180
1.1.3.2.5	$Mn_{1-x}M_xP$ (M=V, Cr, Fe, Co)	182
1.1.3.2.6	$MnP_{1-x}As_x$	190
1.1.3.2.7	$Mn_{1-x}M_xAs$ (M=Ti, V, Cr, Fe, Co, Ni)	197
1.1.3.2.8	$MnAs_{1-x}Sb_x$	206
1.1.3.2.9	$Mn_{1-x}M_xSb$ (M=Ti, V, Cr, Fe, Co, Ni)	208
1.1.3.2.10	$MnSb_{1-x}Sn_x$	213
1.1.3.2.11	Arsenides containing Cr	214
1.1.3.2.12	Antimonides containing Cr	221
1.1.3.2.13	Other mixed pnictides containing Fe	224
1.1.3.2.14	References for 1.1.3.2	227
1.1.4	Compounds and mixed systems with Fe_2P and Cu_2Sb structures	232
1.1.4.1	M_2P compounds with Fe_2P type structure and their mixed systems	232
1.1.4.1.1	M_2P (M=Mn, Fe, Co, Ni)	236
1.1.4.1.2	Mixed system $(M, M')_2P$ (M, M'=Co, Mn, Fe, Ni)	248
1.1.4.1.3	$Fe_2As_xP_{1-x}$ and related systems containing As	261
1.1.4.1.4	Other mixed systems containing P	263
1.1.4.1.5	References for 1.1.4.1	264
1.1.4.2	M_2Y compounds with Cu_2Sb type structure and their mixed systems	265
1.1.4.2.1	M_2As (M=Cr, Mn, Fe)	269
1.1.4.2.2	M_2Sb (M=Mn, Cu)	270
1.1.4.2.3	$MnMGe$ (M=Al, Ga)	273
1.1.4.2.4	$(M, M')_2Y$ and $M_2(Y, Y')$ compounds (M, M'=3d metals; Y, Y'=Sb, As)	275
1.1.4.2.5	$Mn_{1-x}M_x(Al, Ga)Ge$ (M=3d metals)	284
1.1.4.2.6	References for 1.1.4.2	286

1.1.5	Chalcogenide spinels and their mixed systems	288
	References for 1.1.5	373
1.1.6	Other pnictides and chalcogenide	383
1.1.6.1	Chalcopyrite, CuFeS_2 , and its Fe-substituted systems	383
1.1.6.2	Anti- CaF_2 type antimonides, $\text{M}'\text{MSb}$, and their mixed systems	385
1.1.6.3	Heusler type antimonides, $\text{M}'_2\text{MSb}$, and their mixed systems	400
1.1.6.4	References for 1.1.6	423

Subvolume B1: Pnictides and chalcogenides II (Lanthanide monopnictides)

1	Magnetic and related properties of pnictides and chalcogenides	1
1.2	Pnictides and chalcogenides based on lanthanides (W. SUSKI, T. PALEWSKI)	1
1.2.1	Lanthanide monopnictides	1
1.2.1.1	Introduction	1
1.2.1.2	List of frequently used symbols and abbreviations	5
1.2.1.3	Survey of lanthanide monopnictides	11
	La monopnictides	11
	Ce monopnictides	15
	Pr monopnictides	46
	Nd monopnictides	50
	Sm monopnictides	51
	Eu monopnictides	54
	Gd monopnictides	55
	Tb monopnictides	57
	Dy monopnictides	61
	Ho monopnictides	64
	Er monopnictides	67
	Tm monopnictides	70
	Yb monopnictides	73
	Lu monopnictides	81
1.2.1.4	Figures and tables	83
1.2.1.5	References for 1.2.1	418
1.2.2	Lanthanide monochalcogenides	see subvolume B2
1.2.3	Binary lanthanide polypnictides and polychalcogenides	see subvolume B3
1.2.4	Ternary lanthanide pnictides and chalcogenides	see subvolumes B4, B5
	Contents of further subvolumes of III/27	429
	List of editor and authors of Vol. III/27	452

Subvolume B2: Pnictides and chalcogenides II (Lanthanide monochalcogenides)

1	Magnetic and related properties of pnictides and chalcogenides	1
1.2	Pnictides and chalcogenides based on lanthanides	1
1.2.1	Lanthanide monopnictides	see subvolume B1
1.2.2	Lanthanide monochalcogenides (W. SUSKI, T. PALEWSKI)	1
1.2.2.1	Introduction	1
1.2.2.2	List of frequently used symbols and abbreviations	2
1.2.2.3	Survey of lanthanide monochalcogenides	9
	La monochalcogenides	9
	Ce monochalcogenides	11
	Pr monochalcogenides	17
	Nd monochalcogenides	18
	Sm monochalcogenides	19
	Eu monochalcogenides	34
	Gd monochalcogenides	56
	Tb monochalcogenides	59
	Dy monochalcogenides	60
	Ho monochalcogenides	61
	Er monochalcogenides	61
	Tm monochalcogenides	62
	Yb monochalcogenides	77
1.2.2.4	Figures and tables	83
1.2.2.5	References for 1.2.2	421

Subvolume B3: Pnictides and chalcogenides II (Binary lanthanide polypnictides and polychalcogenides)

1	Magnetic and related properties of pnictides and chalcogenides	1
1.2	Pnictides and chalcogenides based on lanthanides	1
1.2.1	Lanthanide monopnictides	see subvolume B1
1.2.2	Lanthanide monochalcogenides	see subvolume B2
1.2.3	Binary lanthanide polypnictides and polychalcogenides (W. SUSKI, T. PALEWSKI)	1
1.2.3.0	Introduction	1
	References for 1.2.3.0	11
1.2.3.1	List of frequently used symbols and abbreviations	13

1.2.3.2	Survey of binary lanthanide pnictides	19
1.2.3.2.1	Ln_4X_3 pnictides with anti- Th_3P_4 structure	19
	Figures and tables for 1.2.3.2.1	28
	References for 1.2.3.2.1	84
1.2.3.2.2	LnX_3 tripnictides EuP_3 , EuAs_3 , and their mutually mixed compounds	87
	Figures and tables for 1.2.3.2.2	93
	References for 1.2.3.2.2	129
1.2.3.2.3	Ln_2X , Ln_5X_3 , Ln_3X_2 and LnX_2 lanthanide pnictides	130
	Figures and tables for 1.2.3.2.3	141
	References for 1.2.3.2.3	176
1.2.3.3	Survey of binary lanthanide chalcogenides	178
1.2.3.3.1	Ln_3X_4 chalcogenides with Th_3P_4 -type structure	178
	Figures and tables for 1.2.3.3.1	199
	References for 1.2.3.3.1	274
1.2.3.3.2	Ln_2X_3 chalcogenides	279
	Figures for 1.2.3.3.2	290
	References for 1.2.3.3.2	316
1.2.3.3.3	LnX_2 , Ln_2X_5 and LnX_3 lanthanide and other polychalcogenides	318
	Figures and tables for 1.2.3.3.3	328
	References for 1.2.3.3.3	360
1.2.4	Ternary lanthanide pnictides and chalcogenides see subvolumes B4, B5	
	Contents of further subvolumes of III/27	362
	List of editor and authors of Vol. III/27	387

Subvolume B4: Pnictides and Chalcogenides II (Ternary lanthanide pnictides)

Part α : 1:1:1 and 1:1:2 type compounds

1	Magnetic and related properties of pnictides and chalcogenides	1
1.2	Pnictides and chalcogenides based on lanthanides	1
1.2.1	Lanthanide monopnictides see subvolume B1	
1.2.2	Lanthanide monochalcogenides see subvolume B2	
1.2.3	Binary lanthanide polypnictides and polychalcogenides see subvolume B3	
1.2.4	Ternary lanthanide pnictides and chalcogenides	1
1.2.4.1	Ternary lanthanide pnictides (Ln-T-X) (T. PALEWSKI, W. SUSKI)	1
1.2.4.1.0	Introduction	1
	Figures for the Introduction	12
1.2.4.1.1	List of frequently used symbols and abbreviations	61
1.2.4.1.2	Survey of ternary lanthanide pnictides	67
1.2.4.1.2.1	Ternary 1:1:1 compounds	67
	Figures and Tables for 1.2.4.1.2.1	106

1.2.4.1.2.2	Ternary 1:1:2 compounds	367
	Figures and Tables for 1.2.4.1.2.2	379
1.2.4.1.2.3	Ternary 1:2:2 compounds	see subvolume B4 β
1.2.4.1.2.4	Ternary 1:4:12 compounds	see subvolume B4 β
1.2.4.1.2.5	Ternary 3:3:4 compounds	see subvolume B4 β
1.2.4.1.2.6	Ternary compounds of various types	see subvolume B4 β
	References for 1.2.4.1	429
	Contents of further subvolumes of III/27	444
	List of editor and authors of Vol. III/27	475

Subvolume B4: Pnictides and Chalcogenides II (Ternary lanthanide pnictides)

Part β : 1:2:2, 1:4:12, 3:3:4 and other type compounds

1	Magnetic and related properties of pnictides and chalcogenides	1
1.2	Pnictides and chalcogenides based on lanthanides	1
1.2.1	Lanthanide monopnictides	see subvolume B1
1.2.2	Lanthanide monochalcogenides	see subvolume B2
1.2.3	Binary lanthanide polypnictides and polychalcogenides	see subvolume B3
1.2.4	Ternary lanthanide pnictides and chalcogenides	1
1.2.4.1	Ternary lanthanide pnictides (Ln-T-X) (T. PALEWSKI, W. SUSKI)	1
1.2.4.1.0	Introduction	1
	Figures for the Introduction	12
1.2.4.1.1	List of frequently used symbols and abbreviations	61
1.2.4.1.2	Survey of ternary lanthanide pnictides	67
1.2.4.1.2.1	Ternary 1:1:1 compounds	see subvolume B4 α
1.2.4.1.2.2	Ternary 1:1:2 compounds	see subvolume B4 α
1.2.4.1.2.3	Ternary 1:2:2 compounds	67
	Figures and Tables for 1.2.4.1.2.3	82
1.2.4.1.2.4	Ternary 1:4:12 compounds	146
	Figures and Tables for 1.2.4.1.2.4	161
1.2.4.1.2.5	Ternary 3:3:4 compounds	247
	Figures and Tables for 1.2.4.1.2.5	257
1.2.4.1.2.6	Ternary compounds of various type	316
	Figures and Tables for 1.2.4.1.2.6	334
	References for 1.2.4.1	404
	Contents of further subvolumes of III/27	419
	List of editor and authors of Vol. III/27	450

Subvolume B5: Pnictides and Chalcogenides II (Ternary lanthanide chalcogenides, misfit compounds, and ternary lanthanide pnictides containing s-or p- electron elements)

1	Magnetic and related properties of pnictides and chalcogenides	1
1.2	Pnictides and chalcogenides based on lanthanides	1
1.2.1	Lanthanide monopnictides	see subvolume B1
1.2.2	Lanthanide monochalcogenides	see subvolume B2
1.2.3	Binary lanthanide polypnictides and polychalcogenides	see subvolume B3
1.2.4	Ternary lanthanide pnictides and chalcogenides	
1.2.4.1	Ternary lanthanide pnictides (Ln-T-X)	see subvolumes B4 α , β
1.2.4.2	Ternary lanthanide chalcogenides, misfit compounds, and ternary lanthanide pnictides containing s- or p-electron elements (T. PALEWSKI, W. SUSKI)	1
1.2.4.2.1	Introduction	1
	Figures for 1.2.4.2.1	10
	References for 1.2.4.2.1	33
1.2.4.2.2	List of frequently used symbols and abbreviations	35
1.2.4.2.3	Survey of ternary chalcogenides containing d-electron elements	43
	Figures and tables for 1.2.4.2.3	64
	References for 1.2.4.2.3	148
1.2.4.2.4	Survey of misfit compounds	151
	Figures and tables for 1.2.4.2.4	176
	References for 1.2.4.2.4	295
1.2.4.2.5	Survey of ternary pnictides and chalcogenides containing s-, p- or f-electron elements	298
	Figures and tables for 1.2.4.2.5	328
	References for 1.2.4.2.5	425
	Contents of further subvolumes of III/27	433
	List of editor and authors of Vol. III/27	465

Subvolume C1: Binary lanthanide oxides

2	Magnetic properties of binary lanthanide and actinide oxides	1
2.1	Binary lanthanide oxides (W. SUSKI, T. PALEWSKI)	1
2.1.1	Introduction	1
2.1.2	List of frequently used symbols and abbreviations	6
2.1.3	Survey of lanthanide oxides	10
	La oxides	10
	Ce oxides	10
	Pr oxides	13
	Nd oxides	16
	Pm oxides	16

	Sm oxides	16
	Eu oxides	18
	Gd oxides	25
	Tb oxides	25
	Dy oxides	27
	Ho oxides	27
	Er oxides	28
	Tm oxides	29
	Yb oxides	29
	Lu oxides	30
2.1.4	Figures and tables	31
2.1.5	References for 2.1	121

Subvolume C2: Binary actinide oxides

2	Magnetic and related properties of binary lanthanide and actinide oxides	1
2.1	Binary lanthanide oxides see subvolume C1	
2.2	Binary actinide oxides (R. TROĆ, D. KACZOROWSKI)	1
2.2.1	Introduction	1
2.2.1.1	General	1
2.2.1.2	Chemical stability of binary actinide oxides	2
2.2.1.3	Preparation technique and phase relations of binary actinide oxides	3
2.2.1.4	Electronic structure of binary actinide oxides	5
2.2.1.5	Magnetic and related properties of binary actinide oxides	7
2.2.1.6	Arrangement of figures and tables	10
2.2.1.7	References for 2.2.1	11
2.2.2	List of frequently used symbols and abbreviations	13
2.2.3	Survey of binary actinide oxides with the CaF_2 -type crystal structure (actinide dioxides)	17
	AnO_2 , comparison of properties	17
	ThO_2	18
	UO_2	19
	UO_{2+x}	28
	$(\text{U}, \text{M})\text{O}_{2+x}$	29
	NpO_2	35
	NpO_{2+x}	37
	$\text{U}_{1-y}\text{Np}_y\text{O}_2$	38
	PuO_2	38
	$\text{U}_{1-y}\text{Pu}_y\text{O}_{2.00}$	39
	$\text{Pu}_{1-y}\text{Np}_y\text{O}_2$	40
	AmO_2	40
	$\text{U}_{1-y}\text{Am}_y\text{O}_{2-x}$	40
	CmO_2	40
	BkO_2	41
	CfO_2	41

2.2.4	Survey of binary actinide oxides with miscellaneous crystal structures	42
	An_2O_3 , comparison of properties	42
	Np_2O_3	42
	Pu_2O_3	42
	Am_2O_3	42
	Cm_2O_3	42
	Bk_2O_3	43
	Cf_2O_3	43
	Cf_7O_{12}	43
	Es_2O_3	43
	Survey of binary uranium oxides UO_x ($x \geq 2.25$)	43
	U_4O_9 ($\text{UO}_{2.25}$)	43
	U_3O_7 ($\text{UO}_{2.33}$)	44
	U_3O_8 ($\text{UO}_{2.67}$)	45
	U_2O_5 ($\text{UO}_{2.5}$)	45
	UO_3	45
2.2.5	Figures and tables	47
2.2.6	References for 2.2.2 - 2.2.5	213
	Contents of further subvolumes of III/27	224
	List of editor and authors of Vol. III/27	248

Subvolume D: Oxy-spinels

3	Magnetic properties of oxy-spinels	1
3.1	Binary oxy-spinels (Co_3O_4 , Fe_3O_4 , $\gamma\text{-Fe}_2\text{O}_3$, Mn_3O_4) (V. A. M. BRABERS, T. E. WHALL)	1
3.1.1	Introduction	1
	a) List of frequently used symbols	1
	b) List of abbreviations	3
3.1.2	Cobalt oxide, Co_3O_4	4
	References for 3.1.2	16
3.1.3	Magnetite, Fe_3O_4	72
	References for 3.1.3	72
3.1.4	Maghemite, $\gamma\text{-Fe}_2\text{O}_3$	77
	References for 3.1.4	85
3.1.5	Hausmannite, Mn_3O_4	86
	References for 3.1.5	99
3.2	Iron oxy-spinels (V. A. M. BRABERS)	100
3.2.1	Introduction	100
	a) General remarks	100
	b) List of frequently used symbols	100
	c) List of abbreviations	103
	d) Survey on tables and figures for 3.2	105

3.2.2	Fe-oxide spinels containing Al, Ca or Cd	106
	References for 3.2.2	141
3.2.3	Fe-oxide spinels containing Co	143
	References for 3.2.3	173
3.2.4	Fe-oxide spinels containing Cr	175
	References for 3.2.4	189
3.2.5	Fe-oxide spinels containing Cu	190
	References for 3.2.5	216
3.2.6	Fe-oxide spinels containing Ga, Ge, In, Li or Mg	218
	References for 3.2.6	267
3.2.7	Fe-oxide spinels containing Mn, Mo	270
	References for 3.2.7	301
3.2.8	Fe-oxide spinels containing Ni	303
	References for 3.2.8	331
3.2.9	Fe-oxide spinels containing Sb, Sn, Ti, V or Zn	333
	References for 3.2.9	365
3.3	Non-iron oxy-spinels (E. AGOSTINELLI, D. FIORANI, A. M. TESTA)	367
3.3.1	Introduction	367
	a) General remarks	367
	b) List of frequently used symbol	367
	c) List of abbreviations	369
3.3.2	General properties of oxide spinels	370
	References for 3.3.2	374
3.3.3	Al-oxide spinels and Al-oxide spinels with substitutions	375
	References for 3.3.3	386
3.3.4	Co-oxide spinels and Co-oxide spinels with substitutions	387
	References for 3.3.4	400
3.3.5	Cr-oxide spinels and Cr-oxide spinels with substitutions	401
	References for 3.3.5	420
3.3.6	Ga-oxide spinels and Ga-oxide spinels with substitutions	421
	References for 3.3.6	426
3.3.7	Ge-oxide spinels and Ge-oxide spinels with substitutions	427
	References for 3.3.7	434
3.3.8	In-oxide spinels and In-oxide spinels with substitutions	434
	References for 3.3.8	436
3.3.9	Mn-oxide spinels and Mn-oxide spinels with substitutions	437
	References for 3.3.9	463
3.3.10	Rh-oxide spinels and Rh-oxide spinels with substitutions	465
	References for 3.3.10	469
3.3.11	Sb-oxide spinels and Sb-oxide spinels with substitutions	469
	References for 3.3.11	475
3.3.12	Sn-oxide spinels and Sn-oxide spinels with substitutions	475
	References for 3.3.12	478
3.3.13	Te-oxide spinels and Te-oxide spinels with substitutions	479
	Reference for 3.3.13	479
3.3.14	Ti-oxide spinels and Ti-oxide spinels with substitutions	480
	References for 3.3.14	495
3.3.15	V-oxide spinels and V-oxide spinels with substitutions	496
	References for 3.3.15	501

Subvolume E: Garnets

4	Magnetic properties of garnets	1
4.1	Iron garnets (P. NOVAK)	1
4.1.1	Introduction	1
4.1.1.1	General remarks	1
4.1.1.2	List of frequently used symbols and abbreviations	1
4.1.2	Magnetic properties	4
4.1.2.1	Magnetic moments and molecular field data	4
4.1.2.1.1	Saturation magnetization and Curie temperature	4
4.1.2.1.2	Molecular-field- and exchange constants	18
4.1.2.1.3	Magnetic moments of the rare earth ions	20
4.1.2.2	Magnetic phase transitions	21
4.1.2.2.1	Spontaneous spin-reorientational transitions	22
4.1.2.2.2	Field induced transitions	23
4.1.2.3	Magnetocrystalline anisotropy	25
4.1.2.3.1	Cubic anisotropy	25
4.1.2.3.2	Non-cubic anisotropy	31
4.1.2.4	Ferromagnetic resonance (FMR)	39
4.1.2.4.1	Resonance field	39
4.1.2.4.2	FMR line width	40
4.1.2.4.3	g-factor	43
4.1.2.5	Spin waves, magnetostatic modes and relaxation	45
4.1.2.5.1	Spin waves and magnetostatic modes	45
4.1.2.5.2	Non-linear effects and relaxation	46
4.1.2.6	Nuclear magnetic resonance (NMR)	49
4.1.2.7	Mössbauer spectroscopy	51
4.1.2.8	Magnetic domains (stripe and bubble domains)	53
4.1.2.8.1	Static properties	53
4.1.2.8.2	Dynamic properties	58
4.1.3	Magnetoelastic properties	60
4.1.3.1	Magnetostriction	60
4.1.3.2	Magnetoelastic waves	63
4.1.4	Elastic properties	63
4.1.5	Optical and magneto-optical properties	64
4.1.5.1	Optical properties	65
4.1.5.1.1	Absorption of light	65
4.1.5.1.2	Reflection of light	73
4.1.5.1.3	Refractive index	75
4.1.5.2	Magneto-optical properties	77
4.1.5.2.1	Faraday rotation	77
4.1.5.2.2	Magnetic circular dichroism (MCD)	93
4.1.5.2.3	Kerr effects	100
4.1.5.2.4	Magnetic linear birefringence (MLB) and nonmagnetic linear birefringence	102
4.1.5.2.5	Magnetic linear dichroism (MLD)	103
4.1.5.3	Photoinduced effects	104
4.1.6	Thermal properties	106
4.1.7	Electrical properties	107
4.1.7.1	Electrical conductivity	107
4.1.7.2	Magnetoresistance and magnetoelectric effect	110

4.1.8	Crystal structure	111
4.1.9	References for 4.1	113
4.1.10	List of iron garnets in III/4a, b, 12a and 27e	125
4.2	Non-iron garnets (Z. A. KAZEI, N. P. KOLMAKOVA, V. I. SOKOLOV)	136
4.2.1	Introduction	136
4.2.1.1	General remarks	136
4.2.1.2	List of frequently used symbols and abbreviation	136
4.2.2	Magnetic susceptibility	140
4.2.2.1	Rare earth garnets	140
4.2.2.2	3d-ion garnets	143
4.2.3	Magnetization and magnetic structure	148
4.2.3.1	Magnetic moments and magnetic anisotropies of terbium, dysprosium and holmium aluminum garnets	149
4.2.3.2	Magnetic moments of rare earth gallium garnets	151
4.2.3.3	Magnetic neutron scattering in dysprosium aluminum garnets	151
4.2.3.4	Magnetic neutron scattering in terbium, holmium and dysprosium gallium garnets	156
4.2.3.5	Magnetization and magnetic phase transitions in manganese germanium garnets	157
4.2.3.6	Garnets with several 3d-ions	160
4.2.4	Results of magnetic resonance experiments	162
4.2.4.1	Electron paramagnetic resonance of paramagnetic metal ions in diamagnetic garnets	162
4.2.4.2	Electron paramagnetic resonance of rare earth ions in diamagnetic garnets	164
4.2.4.3	Electron paramagnetic resonance of impurities in paramagnetic garnets	166
4.2.4.4	Nuclear magnetic resonance	167
4.2.4.5	Antiferromagnetic resonance	167
4.2.5	Optical and magnetooptical properties	169
4.2.5.1	Crystal-field parameters	169
4.2.5.2	Optical spectra and index of refraction	171
4.2.5.3	Information on colour centres	186
4.2.5.4	Further references for results from optical measurements	190
4.2.5.5	Magnetooptical properties	197
4.2.6	Mössbauer spectroscopy	202
4.2.7	Electron spin-lattice relaxation of paramagnetic ions in garnets	205
4.2.8	Thermal properties	207
4.2.8.1	Heat capacity	207
4.2.8.2	Derived thermodynamic functions	215
4.2.8.3	Debye temperature	218
4.2.8.4	Thermal expansion	219
4.2.8.5	Kapitza conductance	222
4.2.8.6	Thermal conductivity	223
4.2.8.7	Ultrasound attenuation	227
4.2.9	Elastic and photoelastic properties	230
4.2.9.1	Elastic and photoelastic constants at room temperature	230
4.2.9.2	Temperature dependences	231
4.2.10	Magnetostriction	232
4.2.10.1	Magnetostriction of rare earth garnets	232
4.2.10.2	Magnetostriction of antiferromagnetic garnets with 3d-ions	235
4.2.11	Electrical properties	237
4.2.11.1	Electrical conductivity and thermoelectric power	238
4.2.11.2	Photoconductivity	242
4.2.12	References for 4.2	243
4.2.13	List of non-iron garnets in III/4b, 12a and 27e	253

Subvolume F1α: Perovskites I (Part α)

5	Magnetic properties of oxides with perovskite, corundum, ilmenite and amorphous structures	1
5.1	Perovskite-type oxides based on 3d elements (E. BURZO)	1
5.1.1	Introduction for Chap. 5.1 - 5.3	1
5.1.1.1	General remarks	1
5.1.1.2	List of frequently used symbols and abbreviations	2
5.1.2	Scandium-based perovskites	6
	References for 5.1.2	8
5.1.3	Titanium-based perovskites	9
5.1.3.1	Crystal structure. Lattice parameters	9
5.1.3.2	Magnetization and magnetic susceptibilities	20
5.1.3.3	Electron paramagnetic resonance (EPR) data	27
5.1.3.4	Nuclear gamma resonance (NGR) data	30
5.1.3.5	Perturbed angular correlations (PAC)	33
5.1.3.6	Electrical resistivities	33
5.1.3.7	Heat capacity	42
5.1.3.8	Dielectric properties	44
5.1.3.9	Electron spectroscopy data	46
5.1.3.10	Infrared spectra	48
5.1.3.11	Optical spectra	49
5.1.3.12	References for 5.1.3	53
5.1.4	Vanadium-based perovskites	62
5.1.4.1	Crystal structure. Lattice parameters	62
5.1.4.2	Magnetization and magnetic susceptibilities	71
5.1.4.3	⁵¹ V nuclear magnetic resonance (NMR) data	84
5.1.4.4	Electron paramagnetic resonance (EPR) data	86
5.1.4.5	Electrical resistivities	87
5.1.4.6	Heat capacity	94
5.1.4.7	Infrared spectra	94
5.1.4.8	Electron spectroscopy data	95
5.1.4.9	Optical spectra	98
5.1.4.10	References for 5.1.4	99
5.1.5	Chromium-based perovskites	102
5.1.5.1	Crystal structure. Lattice parameters	102
5.1.5.2	Magnetization and magnetic susceptibilities	109
5.1.5.3	Neutron diffraction data	112
5.1.5.4	Electrical resistivities	113
5.1.5.5	Dielectric properties	118
5.1.5.6	Thermal properties	118
5.1.5.7	Infrared spectra	119
5.1.5.8	Electron spectroscopy data	119
5.1.5.9	References for 5.1.5	120
5.1.6	Manganese-based perovskites	123
5.1.6.1	Introduction	123
5.1.6.2	Crystal structure. Lattice parameters. Preparation methods	123
5.1.6.3	Magnetization and magnetic susceptibilities	147
5.1.6.4	Neutron diffraction data	166

5.1.6.5	Nuclear magnetic resonance (NMR) data	169
5.1.6.6	Nuclear gamma resonance (NGR) data	170
5.1.6.7	Positron annihilation	171
5.1.6.8	Heat capacity	171
5.1.6.9	Electrical resistivities	173
5.1.6.10	Mechanical properties	186
5.1.6.11	Infrared data	186
5.1.6.12	Magneto-optical properties	188
5.1.6.13	X-ray photoelectron spectroscopy	189
5.1.6.14	References for 5.1.6	194
5.1.7	Iron-based perovskites	200
5.1.7.1	Crystal structure. Lattice parameters	200
5.1.7.2	Magnetization and magnetic susceptibilities	220
5.1.7.3	Neutron diffraction data	227
5.1.7.4	Nuclear gamma resonance (NGR) data	229
5.1.7.5	Electron paramagnetic resonance (EPR) data	249
5.1.7.6	Electrical resistivities	251
5.1.7.7	Magnetoelectric effect	260
5.1.7.8	Dielectric properties	262
5.1.7.9	X-ray photoemission (XPS) and ultraviolet photoemission (UPS) spectroscopy data	264
5.1.7.10	References for 5.1.7	267
5.1.8	Cobalt-based perovskites	274
5.1.8.1	Crystal structure. Lattice parameters. Preparation	274
5.1.8.2	Magnetic properties	288
5.1.8.3	Neutron diffraction data	298
5.1.8.4	Nuclear gamma resonance (NGR) data	299
5.1.8.5	Ferromagnetic resonance data	304
5.1.8.6	Electrical resistivities	305
5.1.8.7	Electron spectroscopy data	311
5.1.8.8	References for 5.1.8	312
5.1.9	Nickel-based perovskites	316
5.1.9.1	Crystal structure. Lattice parameters	316
5.1.9.2	Magnetization and magnetic susceptibilities	326
5.1.9.3	Neutron diffraction data	332
5.1.9.4	Electron paramagnetic resonance (EPR) data	338
5.1.9.5	Electrical resistivities	338
5.1.9.6	Heat capacity	342
5.1.9.7	Optical studies	342
5.1.9.8	X-ray absorption spectroscopy	342
5.1.9.9	References for 5.1.9	343

Subvolume F1 β : Perovskites I (Part β)

5	Magnetic properties of oxides with perovskite, corundum, ilmenite and amorphous structures	1
5.1	Perovskite-type oxides based on 3d elements (E. BURZO)	1
5.1.1	Introduction for Chap. 5.1 - 5.3	1
5.1.1.1	General remarks	1

5.1.1.2	List of frequently used symbols and abbreviations	2
5.1.2 - 5.1.9	see subvolume F1 α
5.1.10	Copper-based perovskites	6
5.1.10.1	Crystal structure. Lattice parameters	6
5.1.10.2	Magnetization and magnetic susceptibilities	19
5.1.10.3	Neutron diffraction data	28
5.1.10.4	Nuclear gamma resonance (NGR) data	30
5.1.10.5	Nuclear quadrupol resonance (NQR) data	31
5.1.10.6	Electron paramagnetic resonance (EPR) data	32
5.1.10.7	Heat capacity	32
5.1.10.8	Electrical resistivities	33
5.1.10.9	X-ray photoelectron spectroscopy	38
5.1.10.10	Optical studies	39
5.1.10.11	Muon spin rotation	39
5.1.10.12	References for 5.1.10	40
5.1.11	Mixed transition metal perovskites	45
5.1.11.1	Crystal structure. Lattice parameters	45
5.1.11.2	Magnetization and magnetic susceptibilities	65
5.1.11.3	Neutron diffraction data	87
5.1.11.4	Nuclear magnetic resonance (NMR) data	88
5.1.11.5	Electron paramagnetic resonance (EPR) data	91
5.1.11.6	Nuclear gamma resonance (NGR) data	93
5.1.11.7	Electrical resistivities	107
5.1.11.8	Magnetoelectric effect	121
5.1.11.9	Dielectric properties	121
5.1.11.10	X-ray electron spectroscopy	125
5.1.11.11	Infrared and optical spectroscopy	126
5.1.11.12	References for 5.1.11	128
5.2	Perovskite-type oxides based on 4d or 5d elements (E. BURZO)	135
5.2.1	Rhutenium-based perovskites	135
5.2.1.1	Crystal structure. Lattice parameters	135
5.2.1.2	Magnetic properties	150
5.2.1.3	Neutron diffraction data	164
5.2.1.4	Nuclear gamma resonance (NGR) data	165
5.2.1.5	Magnetic anisotropy	171
5.2.1.6	Electrical resistivities	172
5.2.1.7	Infrared spectra	175
5.2.1.8	References for 5.2.1	176
5.2.2	Other 4d element perovskites	179
5.2.2.1	Crystal structure. Lattice parameters	179
5.2.2.2	Magnetization and magnetic susceptibilities	196
5.2.2.3	Neutron diffraction data	202
5.2.2.4	Electron paramagnetic resonance (EPR) data	204
5.2.2.5	Nuclear gamma resonance (NGR) data	204
5.2.2.6	Heat capacity	205
5.2.2.7	Electrical resistivities	205
5.2.2.8	Dielectric properties	213
5.2.2.9	Optical data	217
5.2.2.10	Infrared spectra	218
5.2.2.11	Photoelectron spectroscopy	218
5.2.2.12	References for 5.2.2	220

5.2.3	Iridium-based perovskites	226
5.2.3.1	Crystal structure. Lattice parameters	226
5.2.3.2	Magnetic properties	232
5.2.3.3	Neutron diffraction data	241
5.2.3.4	Nuclear gamma resonance (NGR) data	241
5.2.3.5	Electrical resistivities	243
5.2.3.6	Infrared spectra	244
5.2.3.7	References for 5.2.3	244
5.2.4	Other 5d element perovskites	246
5.2.4.1	Crystal structure. Lattice parameters	246
5.2.4.2	Magnetization and magnetic susceptibilities	262
5.2.4.3	Neutron diffraction data	269
5.2.4.4	Nuclear gamma resonance (NGR) data	270
5.2.4.5	Electron paramagnetic resonance (EPR) data	271
5.2.4.6	Electrical resistivities	271
5.2.4.7	Dielectric properties	272
5.2.4.8	Birefringence	273
5.2.4.9	Raman spectroscopy. IR spectroscopy	274
5.2.4.10	References for 5.2.4	275
5.3	Miscellaneous perovskite-type oxides ([AC ₃](B ₄)O ₁₂ -type perovskites (E. BURZO)	280
5.3.1	Crystal structure. Lattice parameters. Preparation	280
5.3.2	Magnetization and magnetic susceptibilities	290
5.3.3	Neutron diffraction data	297
5.3.4	Nuclear magnetic resonance (NMR) data	301
5.3.5	Nuclear gamma resonance (NGR) data	301
5.3.6	Electrical resistivities	303
5.3.7	Elastic properties	304
5.3.8	Kerr effect	304
5.3.9	Infrared spectra	305
5.3.10	References for 5.3	307

Subvolume F2: Perovskite-type layered cuprates (high- T_c superconductors and related compounds)

5.4	Perovskite-type layered cuprates (high- T_c superconductors and related compounds) (Z.A. KAZEI, I.B. KRYNETSKII)	1
5.4.1	Introduction	1
5.4.1.1	General remarks	1
5.4.1.2	List of frequently used symbols and abbreviations	3
5.4.2	Magnetic susceptibility and concentration phase diagrams	8
5.4.2.1	Rare earth cuprates Ln ₂ CuO _{4-y} (2-1-4)	8
5.4.2.1.1	Pure La ₂ CuO ₄ , Y ₂ CuO ₄ and model compounds Sr ₂ CuO ₂ Cl ₂ , CuO	9
5.4.2.1.2	Doped La _{2-x} M' _x Cu _{1-y} M'' _y O _{4-δ} (M' = Ba, Bi, Ca, Sr; M'' = Li, Ni, Zn)	16
5.4.2.1.3	Ln ₂ CuO _{4-y} with magnetic rare earth ions (Ln = Pr–Gd, Dy–Tm)	23

5.4.2.2	Rare earth cuprates $\text{LnBa}_2\text{Cu}_3\text{O}_{7-y}$ (1-2-3), $\text{YBa}_2\text{Cu}_4\text{O}_8$ (1-2-4)	32
5.4.2.2.1	Pure compounds $\text{YBa}_2\text{Cu}_3\text{O}_x$ and $\text{YBa}_2\text{Cu}_4\text{O}_8$	32
5.4.2.2.2	Doped $\text{Y}(\text{Ba}_{0.55}\text{La}_{0.45})_2\text{Cu}_3\text{O}_{7+y}$, $\text{YBa}_2(\text{Cu}_{1-y}\text{M}_y)_3\text{O}_x$ ($\text{M} = \text{Co, Fe, Ni, Sc, Zn}$), and $\text{Y}_{1-x}\text{Na}_x\text{Ba}_2\text{Cu}_3\text{O}_{7-d}$	39
5.4.2.2.3	$\text{LnBa}_2\text{Cu}_3\text{O}_{7-y}$ with magnetic rare earth ions ($\text{Ln} = \text{Pr-Gd, Dy-Yb}$)	45
5.4.2.2.4	Summary of susceptibility parameters and transition temperatures for $\text{LnBa}_2\text{Cu}_3\text{O}_{7-y}$ series	57
5.4.2.3	Bi- and Tl- based layered cuprates	64
5.4.2.4	Related compounds $\text{Ln}_2\text{Cu}_2\text{O}_5$ ($\text{Ln} = \text{Tb-Lu, Y, Sc, In}$) (2-2-5)	69
5.4.2.5	Related compounds $\text{Ln}_2\text{BaCuO}_5$ ($\text{Ln} = \text{Dy, Ho, Er, Y}$) (2-1-1-5)	73
5.4.3	Magnetization and magnetic phase transitions	75
5.4.3.1	Pure La_2CuO_4 and doped $\text{La}_{2-x}\text{M}'_x\text{Cu}_{1-y}\text{M}''_y\text{O}_4$ ($\text{M}' = \text{Y, Ba, Sr}$; $\text{M}'' = \text{Fe, Ni, Zn}$). Model compounds $\text{Sr}_2\text{CuO}_2\text{Cl}_2$, CuO , Bi-based cuprates	75
5.4.3.2	$\text{Ln}_2\text{CuO}_{4-y}$ with magnetic rare earth ions ($\text{Ln} = \text{Pr-Gd}$)	80
5.4.3.3	Rare earth cuprates $\text{LnBa}_2\text{Cu}_3\text{O}_{7-y}$ ($\text{Ln} = \text{Y, Pr-Gd, Dy-Yb}$)	86
5.4.3.4	Rare earth cuprates $\text{Ln}_2\text{Cu}_2\text{O}_5$ ($\text{Ln} = \text{Y, Dy-Yb}$) and $\text{Ln}_2\text{BaCuO}_5$ ($\text{Ln} = \text{Gd, Dy-Er}$)	96
5.4.4	Magnetic neutron scattering and diffraction	102
5.4.4.1	Magnetic structures and spin correlations	102
5.4.4.1.1	La_2CuO_4 , $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$, Bi_2CuO_4 and model compounds $\text{Sr}_2\text{CuO}_2\text{Cl}_2$, CuO	102
5.4.4.1.2	$\text{Ln}_2\text{CuO}_{4-y}$ with magnetic rare earth ions (Pr, Nd, Gd)	110
5.4.4.1.3	Pure and doped $\text{LnBa}_2\text{Cu}_3\text{O}_x$ ($\text{Ln} = \text{Y, Pr, Nd}$), $\text{TlBa}_2\text{YCu}_2\text{O}_7$	117
5.4.4.1.4	$\text{LnBa}_2\text{Cu}_3\text{O}_{7-y}$ with magnetic rare earth ions ($\text{Ln} = \text{Gd, Dy-Tm}$)	128
5.4.4.1.5	Rare earth cuprates $\text{DyBa}_2\text{Cu}_4\text{O}_8$ and $\text{ErBa}_2\text{Cu}_4\text{O}_8$ (1-2-4)	136
5.4.4.1.6	Related compounds $\text{Ln}_2\text{Cu}_2\text{O}_5$	139
5.4.4.2	Inelastic neutron scattering and crystal field parameters	141
5.4.4.2.1	Pure and doped Nd_2CuO_4	141
5.4.4.2.2	Rare earth cuprates $\text{LnBa}_2\text{Cu}_3\text{O}_{7-y}$	144
5.4.5	Magnetic resonance experiments	157
5.4.5.1	Nuclear resonance measurements	157
5.4.5.1.1	Pure and doped La_2CuO_4 , model compound CuO , pure and doped Nd_2CuO_4	158
5.4.5.1.2	Pure and doped $\text{LnBa}_2\text{Cu}_3\text{O}_x$ ($\text{Ln} = \text{Y, Pr-Gd, Dy-Er, Yb}$), $\text{Bi}_2\text{Sr}_2(\text{Ca}_{1-x}\text{Y}_x)\text{Cu}_2\text{O}_{8+y}$, $\text{Pb}_2\text{Sr}_2\text{YCu}_3\text{O}_{8+\delta}$	162
5.4.5.2	Electron paramagnetic and antiferromagnetic resonance measurements	170
5.4.5.2.1	Pure and doped $\text{Ln}_2\text{CuO}_{4-y}$ ($\text{Ln} = \text{La, Gd}$)	170
5.4.5.2.2	$\text{YBa}_2\text{Cu}_3\text{O}_7$ and related compounds, Bi-based cuprates	172
5.4.5.2.3	$\text{Y}_{1-x}\text{Gd}_x\text{Ba}_2\text{Cu}_3\text{O}_{7-y}$ and $\text{Y}_{2-x}\text{Gd}_x\text{BaCuO}_5$	176
5.4.5.3	μ^+ SR measurements	186
5.4.5.3.1	Pure and doped Ln_2CuO_4 ($\text{Ln} = \text{La, Pr, Nd, Sm}$), model compounds $\text{Sr}_2\text{CuO}_2\text{Cl}_2$, CuO	186
5.4.5.3.2	Pure and doped compounds $\text{LnBa}_2\text{Cu}_3\text{O}_x$ ($\text{Ln} = \text{Y, Pr, Gd, Dy-Er}$), related compounds Y_2BaCuO_5 and BaCuO_2	191
5.4.5.3.3	Bi-based cuprates	198

5.4.6	Mössbauer spectroscopy	200
5.4.6.1	Pure and doped Ln_2CuO_4 ($\text{Ln} = \text{La, Eu, Gd}$), La_2CoO_4 , SrLaFeO_4	200
5.4.6.2	Pure and doped $\text{LnBa}_2(\text{Cu}_{1-x}\text{Fe}_x)_3\text{O}_z$ ($\text{Ln} = \text{Dy, Pr, Gd, Er, Yb}$)	203
5.4.6.2.1	Mössbauer spectra for rare earth elements	203
5.4.6.2.2	Mössbauer spectra of ^{57}Fe doped $\text{LnBa}_2\text{Cu}_3\text{O}_z$ ($\text{Ln} = \text{Y, Pr, Gd}$), $\text{YBa}_2\text{Cu}_4\text{O}_8$ and related compounds	204
5.4.6.3	Compounds related to Bi-based high- T_c cuprates	214
5.4.7	Heat capacity and derived thermodynamic properties	215
5.4.7.1	$\text{La}_{2-x}\text{M}_x\text{CuO}_{4-y}$ ($\text{M} = \text{Sr, Ba}$), $\text{YBa}_2\text{Cu}_3\text{O}_{7-y}$ and $\text{Bi}_2\text{Sr}_2(\text{Ca, Y})\text{Cu}_2\text{O}_{8-y}$	215
5.4.7.2	$\text{Ln}_2\text{CuO}_{4-y}$ with magnetic rare earth ions ($\text{Ln} = \text{Pr-Gd}$)	224
5.4.7.3	$\text{LnBa}_2\text{Cu}_3\text{O}_{7-y}$ with magnetic rare earth ions ($\text{Ln} = \text{Pr-Gd, Dy-Yb}$)	227
5.4.7.4	Related compounds $\text{Ln}_2\text{Cu}_2\text{O}_5$ ($\text{Ln} = \text{Tb-Yb, Y, Lu}$), $\text{Ln}_2\text{BaCuO}_5$ ($\text{Ln} = \text{Sm-Gd, Dy-Yb, Y}$), and Y_2BaZnO_5	241
5.4.8	Thermal expansion and magnetostriction	244
5.4.8.1	Thermal expansion of $\text{LnBa}_2\text{Cu}_3\text{O}_{7-x}$ ($\text{Ln} = \text{Y, Sm-Gd, Dy-Tm}$)	244
5.4.8.2	Magnetostriction	246
5.4.8.2.1	La_2CuO_4	247
5.4.8.2.2	$\text{LnBa}_2\text{Cu}_3\text{O}_{7-x}$ ($\text{Ln} = \text{Y, Pr, Nd, Sm-Gd, Dy-Tm}$) and related compounds $\text{Ln}_2\text{Cu}_2\text{O}_5$ ($\text{Ln} = \text{Y, Dy-Lu}$)	248
5.4.9	Transport properties	255
5.4.10	References for 5.4	259

Subvolume F2S: Perovskite-type layered cuprates (high- T_c superconductors and related compounds)

Supplement and extension to Vol. III/27F2.

5	Magnetic properties of oxides with perovskite, corundum and ilmenite type structures and amorphous oxides	1
5.4	Perovskite-type layered cuprates (high- T_c superconductors and related compounds) (Z.A. KAZEI, I.B. KRYNETSKII)	1
Numbering of chapters in this supplement is the same as in III/27F2. For reasons of simplicity the prefix 5.4 is dropped, i.e. section 5.4.1 is given as 1 only, 5.4.1.1 as 1.1, etc..		
1	Introduction	1
1.1	General remarks	1
1.2	List of frequently used symbols and abbreviations	3
2	Magnetic susceptibilities and concentration phase diagrams	10
2.1	Rare earth cuprates Ln_2CuO_4 (2-1-4)	10
2.1.1	Pure $\text{La}_2\text{CuO}_{4\pm\delta}$, $\text{La}_2\text{NiO}_{4\pm\delta}$, Y_2CuO_4 , Bi_2CuO_4 and model compounds CuO , BaCuO_{2+x}	10
2.1.2	Doped $\text{La}_{2-x}\text{M}'_x\text{Cu}_{1-y}\text{M}''_y\text{O}_{4-\delta}$ ($\text{M}' = \text{Bi, Sr}$; $\text{M}'' = \text{Co, Fe, Ga, Ni, Zn}$)	16
2.1.3	Pure and doped $\text{Ln}_{2-x}\text{M}_x\text{CuO}_{4-\delta}$, $\text{Ln}_2\text{NiO}_{4-\delta}$ with magnetic rare earth or transuranium ions ($\text{Ln} = \text{Pr-Tm, Cm}$; $\text{M} = \text{Ce, Ln, Sr, Y}$)	25

2.2	Rare earth cuprates $\text{LnBa}_2\text{Cu}_3\text{O}_{7-\delta}$ (1-2-3), $\text{LnBa}_2\text{Cu}_4\text{O}_{8-\delta}$ (1-2-4), $\text{Ln}_2\text{Ba}_4\text{Cu}_7\text{O}_{15-\delta}$ (2-4-7)	37
2.2.1	Pure $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$ and $\text{YBa}_2\text{Cu}_4\text{O}_{8-\delta}$	37
2.2.2	Doped $\text{YBa}_2\text{Cu}_{3-y}\text{M}_y\text{O}_{7-\delta}$ and $\text{YBa}_2\text{Cu}_{4-y}\text{M}_y\text{O}_{8-\delta}$ ($\text{M} = \text{Co}, \text{Fe}, \text{Zn}$)	40
2.2.3	Pure and substituted $\text{LnM}_2\text{Cu}_3\text{O}_{7-\delta}$, $\text{LnM}_2\text{Cu}_4\text{O}_{8-\delta}$, $\text{Ln}_2\text{M}_4\text{Cu}_7\text{O}_{15-\delta}$, $\text{LnM}_2\text{Cu}_2\text{NbO}_{8-\delta}$ with magnetic rare earth ions ($\text{Ln} = \text{Pr} - \text{Yb}$; $\text{M} = \text{Ba}, \text{Sr}$)	44
2.3	Bi-, Hg-, Pb-, Tl- based layered cuprates and spin ladder systems (Sr, A) $_{14}\text{Cu}_{24}\text{O}_{41}$, Sr_2CuO_3 , (La, Sr) $\text{CuO}_{2.5}$ ($\text{A} = \text{Ca}, \text{Ba}, \text{La}$)	61
2.4	Related compounds $\text{Ln}_2\text{Cu}_2\text{O}_5$ (2-2-5), Ln_2BaMO_5 (2-1-1-5) ($\text{Ln} = \text{Pr} - \text{Yb}, \text{Y}$; $\text{M} = \text{Co}, \text{Cu}, \text{Ni}, \text{Fe}, \text{Zn}$)	69
3	Magnetization and magnetic phase transitions	76
3.1	Pure and doped La_2CuO_4 , model compounds CuO , $\text{Ca}_2\text{CuO}_2\text{Cl}_2$, $\text{Sr}_2\text{CuO}_2\text{Cl}_2$, $\text{Ba}_2\text{Cu}_3\text{O}_4\text{Cl}_2$, and Bi_2CuO_4	76
3.2	Pure and doped Ln_2CuO_4 ($\text{Ln} = \text{Y}, \text{Pr}, \text{Nd}, \text{Sm} - \text{Tb}, \text{Ho}$)	81
3.3	Pure and doped $\text{LnBa}_2\text{Cu}_3\text{O}_x$ ($\text{Ln} = \text{Y}; \text{Pr}, \text{Nd}, \text{Gd}, \text{Dy}$)	91
3.3.1	Pure and doped $\text{YBa}_2\text{Cu}_3\text{O}_x$	91
3.3.2	Pure and doped $\text{LnBa}_2\text{Cu}_3\text{O}_x$ with magnetic rare earth ions ($\text{Ln} = \text{Pr}, \text{Nd}, \text{Gd}, \text{Dy}$)	96
3.4	Related compounds $\text{Ln}_2\text{Cu}_2\text{O}_5$ ($\text{Ln} = \text{Y}, \text{Sc}, \text{In}, \text{Tm}, \text{Yb}, \text{Lu}$)	100
3.5	Layered cuprates of quaternary family (M-2122)	104
3A	Electric polarization and magnetoelectric effect	110
3A.1	Pure cuprates $\text{Ln}_2\text{CuO}_{4-y}$ with magnetic rare earth ions ($\text{Ln} = \text{La}, \text{Nd}, \text{Sm}, \text{Gd}$)	110
4	Magnetic neutron scattering and diffraction	114
4.1	Magnetic structures and spin correlations	114
4.1.1	Pure $\text{La}_2\text{CuO}_{4\pm\delta}$, $\text{La}_2\text{NiO}_{4\pm\delta}$, Bi_2CuO_4 and model compounds $\text{M}_2\text{CuO}_2\text{Cl}_2$ ($\text{M} = \text{Ca}, \text{Sr}$)	114
4.1.2	Doped $\text{La}_{2-x}\text{M}'_x\text{Cu}_{1-y}\text{M}''_y\text{O}_{4-\delta}$ ($\text{M}' = \text{Ba}, \text{Sr}, \text{Nd}$; $\text{M}'' = \text{Zn}$)	122
4.1.3	Pure and doped $\text{Ln}_{2-x}\text{M}_x\text{CuO}_{4-\delta}$, $\text{Ln}_2\text{NiO}_{4-\delta}$ with magnetic rare earth ions ($\text{Ln} = \text{La}, \text{Pr} - \text{Gd}$; $\text{M} = \text{Ce}, \text{Ln}, \text{Sr}$)	130
4.1.4	Pure and doped $\text{YBa}_2(\text{Cu}_{1-x}\text{M}_x)_3\text{O}_{7-\delta}$, $\text{YBa}_2(\text{Cu}_{1-x}\text{M}_x)_4\text{O}_{8-\delta}$ ($\text{M} = \text{Al}, \text{Co}, \text{Fe}, \text{Ni}, \text{Zn}$)	139
4.1.5	Pure and substituted $\text{LnM}_2\text{Cu}_3\text{O}_{7-\delta}$, $\text{LnM}_2\text{Cu}_4\text{O}_{8-\delta}$, $\text{Ln}_2\text{M}_4\text{Cu}_7\text{O}_{15-\delta}$, $\text{LnM}_2\text{Cu}_2\text{NbO}_{8-\delta}$ with magnetic rare earth ions ($\text{Ln} = \text{Pr} - \text{Er}$; $\text{M} = \text{Ba}, \text{Sr}$)	151
4.1.6	Bi-, Tl- and Hg- based layered cuprates and spin ladder systems	165
4.1.7	Related compounds $\text{Ln}_2\text{Cu}_2\text{O}_5$ (2-2-5), Ln_2BaMO_5 (2-1-1-5) ($\text{Ln} = \text{Pr} - \text{Yb}, \text{Y}$; $\text{M} = \text{Co}, \text{Cu}, \text{Ni}, \text{Fe}, \text{Zn}$)	166
4.2	Inelastic neutron scattering and crystal field parameters	171
4.2.1	Pure and doped $\text{Ln}_2\text{Cu}_{1-x}\text{M}_x\text{O}_{4-\delta}$ with magnetic rare earth ions ($\text{Ln} = \text{La}, \text{Pr}, \text{Nd}$; $\text{M} = \text{Ce}$)	171
4.2.2	$\text{LnBa}_2\text{Cu}_3\text{O}_{7-\delta}$, $\text{LnBa}_2\text{Cu}_4\text{O}_{8-\delta}$ with magnetic rare earth ions ($\text{Ln} = \text{Pr} - \text{Er}$)	181
4.2.3	Related compounds $\text{Ln}_2\text{Cu}_2\text{O}_5$ (2-2-5) ($\text{Ln} = \text{Er}$)	200
5	Magnetic resonance experiments	201
5.1	Nuclear resonance measurements	201
5.1.1	Pure and doped Ln_2CuO_4 ($\text{Ln} = \text{La}, \text{Pr}, \text{Nd}$)	201
5.1.1.1	Pure and doped $\text{La}_{2-x}\text{M}'_x\text{Cu}_{1-y}\text{M}''_y\text{O}_4$ ($\text{M}' = \text{Sr}, \text{Ba}, \text{Eu}$; $\text{M}'' = \text{Li}, \text{Zn}$)	202
5.1.1.2	Doped Ln_2CuO_4 with rare earth ions ($\text{Ln} = \text{Pr}, \text{Nd}$), model compounds CuO , $\text{Sr}_2\text{CuO}_2\text{Cl}_2$, and $\text{La}_4\text{Ba}_2\text{Cu}_2\text{O}_{10}$	209
5.1.2	$\text{LnBa}_2\text{Cu}_3\text{O}_x$ and $\text{LnBa}_3\text{Cu}_4\text{O}_8$	211
5.1.2.1	Pure and doped $\text{LnBa}_2\text{Cu}_3\text{O}_x$ ($\text{Ln} = \text{Y}, \text{Pr}, \text{Gd}, \text{Tm}$)	211

5.1.2.2	Pure and doped $\text{LnBa}_2\text{Cu}_4\text{O}_8$ (Ln = Y, Gd), $\text{Y}_2\text{Ba}_4\text{Cu}_7\text{O}_{15}$ and $\text{La}_{1.89}\text{Ca}_{1.11}\text{Cu}_2\text{O}_6$	220
5.1.2.3	$\text{LnSr}_2\text{Cu}_2\text{GaO}_7$ (Ln = Y, Nd, Pr, Gd) and $\text{LnBa}_2\text{Cu}_2\text{NbO}_8$ (Ln = Y, Nd, Pr, La)	225
5.1.3	Hg- and Bi- based cuprates	227
5.2	Electron paramagnetic and antiferromagnetic resonance measurements	230
5.2.1	Pure and doped Ln_2CuO_4 (Ln = La, Pr, Nd, Gd), model compounds $\text{Sr}_2\text{CuO}_2\text{F}_{2.4}$, $\text{Ba}_2\text{Cu}_3\text{O}_4\text{Cl}_2$, and Bi_2CuO_4	230
5.2.2	Pure and doped $\text{LnBa}_2\text{Cu}_3\text{O}_6$ (Ln = Y, Pr, Sm, Gd, Er)	236
5.2.2.1	Related compounds $\text{Ln}_2\text{Cu}_2\text{O}_5$ (Ln = Y, In, Lu) and $\text{Ln}_2\text{BaCuO}_5$ (Ln = Y, Gd, Yb)	240
5.2.3	Tl- and Bi- based cuprates	243
5.3	μ^+ SR measurements	245
5.3.1	Pure and doped $\text{La}_{2-x}\text{M}'_x\text{Cu}_{1-y}\text{M}''_y\text{O}_4$ ($\text{M}' = \text{Sr, Ba, Nd}$; $\text{M}'' = \text{Li, Zn}$)	245
5.3.2	Pure and doped $\text{LnBa}_2\text{Cu}_3\text{O}_x$ (Ln = Y, Gd), $\text{La}_2\text{SrCu}_2\text{O}_{6+\delta}$	249
6	Mössbauer spectroscopy	251
6.1	Pure and doped Ln_2CuO_4 (Ln = La, Gd), model compounds $(\text{Sr,Ca})_2\text{CuO}_2\text{Cl}_2$, Sr_2CuO_3 and CuO	251
6.1.1	Transmission Mössbauer spectroscopy	251
6.1.2	Emission Mössbauer spectroscopy	258
6.2	Pure and doped $\text{LnBa}_2\text{Cu}_3\text{O}_x$ (Ln = Y, Pr, Nd, Gd, Er, Tm, Yb)	259
6.2.1	Transmission Mössbauer spectroscopy	259
6.2.1.1	Pure and doped $\text{YBa}_2\text{Cu}_3\text{O}_x$, $\text{YBa}_2\text{Cu}_4\text{O}_{8+\delta}$	259
6.2.1.2	Pure and doped $\text{LnBa}_2\text{Cu}_3\text{O}_x$ with magnetic rare earth ions (Ln = Pr, Gd, Dy, Er, Yb).	265
6.2.2	Emission Mössbauer spectroscopy	271
6.3	Compounds related to $\text{LnBa}_2\text{Cu}_3\text{O}_x$	272
6.4	Bi- and Pb- based cuprates	279
7	Heat capacity and derived thermodynamic properties	284
7.1	Pure and substituted $\text{La}_{2-x}\text{M}'_x\text{Cu}_{1-y}\text{M}''_y\text{O}_{4\pm\delta}$ ($\text{M}' = \text{Ba, Sr}$; $\text{M}'' = \text{Zn}$)	284
7.2	Pure and substituted $\text{Ln}_{2-x}\text{M}_x\text{CuO}_{4-\delta}$ with magnetic rare earth ions (Ln = Pr – Yb; M = Ce, Ln)	286
7.3	Pure and substituted $\text{LnM}'_2\text{Cu}_{3-y}\text{M}''_y\text{O}_{7-\delta}$, $\text{LnM}'_2\text{Cu}_4\text{O}_{8-\delta}$, $\text{Ln}_2\text{M}'_4\text{Cu}_7\text{O}_{15-\delta}$, $\text{LnM}'_2\text{Cu}_2\text{NbO}_{8-\delta}$ with magnetic rare earth ions (Ln = Pr – Yb, Y; $\text{M}' = \text{Ba, Sr}$; $\text{M}'' = \text{Al, Ga, Mo}$)	291
7.4	Bi-, Hg-, Pb-, Tl- based layered cuprates	307
7.5	Related compounds $\text{Ln}_2\text{Cu}_2\text{O}_5$ (2-2-5), Ln_2BaMO_5 (2-1-1-5) (Ln = Pr – Yb, Y; M = Cu, Zn)	310
8	Elastic and magnetoelastic properties	312
8.1	Elastic moduli and sound velocity	312
8.1.1	$\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$	312
8.1.2	Pure and doped Ln_2CuO_4 with magnetic rare earth ions (Ln = Nd, Gd)	313
8.1.3	$\text{LnBa}_2\text{Cu}_3\text{O}_x$ (Ln = Gd, Dy)	315
8.2	Thermal expansion	316
8.2.1	Pure Ln_2CuO_4 with magnetic rare earth ions (Ln = Pr, Nd, Sm – Gd) and $\text{LnBa}_2\text{Cu}_3\text{O}_{7-\delta}$ (Ln = Pr, Dy)	316
8.3	Magnetostriction	317
8.3.1	$\text{DyBa}_2\text{Cu}_3\text{O}_{6.8}$, model compound CuO , and rare earth cuprates $\text{Ln}_2\text{Cu}_2\text{O}_5$ (Ln = Dy, Ho)	317
9	References for 1 - 8	320
	Contents of further subvolumes of III/27	354
	List of editor and authors of Vol. III/27	382

Subvolume F3: Perovskites II, oxides with corundum, ilmenite and amorphous structures

5.5	Perovskite-type oxides RMO_3 (R = rare earth element, M = 3d element or Al) (H.P.J. WIJN)	1
5.5.1	Introduction	1
5.5.1.1	General remarks	1
5.5.1.2	Magnetic configurations	2
5.5.1.3	List of frequently used symbols and abbreviations	5
5.5.2	AlO_3 compounds	8
5.5.3	RScO_3 compounds	22
5.5.4	RTiO_3 compounds	25
5.5.5	RVO_3 compounds	46
5.5.6	RCrO_3 compounds	56
5.5.7	RMnO_3 compounds	91
5.5.8	RFeO_3 compounds	101
5.5.8.1	LaFeO_3 compounds	104
5.5.8.2	CeFeO_3	107
5.5.8.3	PrFeO_3	107
5.5.8.4	NdFeO_3 compounds	108
5.5.8.5	SmFeO_3 compounds	110
5.5.8.6	EuFeO_3 compounds	116
5.5.8.7	GdFeO_3 compounds	118
5.5.8.8	TbFeO_3 compounds	120
5.5.8.9	DyFeO_3 compounds	125
5.5.8.10	HoFeO_3 compounds	134
5.5.8.11	ErFeO_3 compounds	138
5.5.8.12	TmFeO_3 compounds	143
5.5.8.13	YbFeO_3	146
5.5.8.14	LuFeO_3 compounds	146
5.5.8.15	YFeO_3 compounds	147
5.5.9	RCoO_3 compounds	152
5.5.10	RNiO_3 compounds	158
5.5.11	References for 5.5	159
5.6	Oxides with corundum and ilmenite structures (Y. ENDOH, K. KAKURAI, A.K. KATORI)	173
5.6.1	Introduction	173
5.6.2	List of frequently used symbols and abbreviations	173
5.6.3	Oxides with corundum structure	176
5.6.3.1	Binary oxides M_2O_3 ; M = 3d transition element	177
5.6.3.2	Pseudo-binary and ternary oxides $(\text{M}_{1-x}\text{M}'_x)_2\text{O}_3$; M, M' = 3d transition elements	190
5.6.4	Oxides with ilmenite structure	205
5.6.4.1	Single ternary oxides $\text{MM}'\text{O}_3$; M, M' = 3d transition elements	205
5.6.4.2	Mixed pseudo-ternary Ti oxides $(\text{M}_x\text{M}'_{1-x})\text{TiO}_3$; M, M' = Mn, Fe, Co or Ni	221
5.6.5	Solid solutions between oxides with corundum and ilmenite structure	233
5.6.6	References for 5.6	235

5.7	Amorphous oxides (M.S. SEEHRA, G. SRINIVASAN)	239
5.7.1	Introduction	239
5.7.1.0	Scope of the review	239
5.7.1.1	Symbols and abbreviations	240
5.7.2	Oxide glasses	242
5.7.2.0	General remarks	242
5.7.2.1	Phosphate glasses	242
5.7.2.1.0	General remarks	242
5.7.2.1.1	Ti - based phosphates	243
5.7.2.1.2	V - based phosphates	244
5.7.2.1.3	Cr - based phosphates	244
5.7.2.1.4	Mn - based phosphates	246
5.7.2.1.5	Fe - based phosphates	246
5.7.2.1.6	Co - based phosphates	247
5.7.2.1.7	Spinel ferrite based phosphates	248
5.7.2.2	Borate glasses	249
5.7.2.2.0	General remarks	249
5.7.2.2.1	Mn - borate glasses	250
5.7.2.2.2	Fe - alkali - borate glasses	252
5.7.2.2.3	Fe - BaO - borate glasses	253
5.7.2.2.4	Fe - CaO - borate glasses	256
5.7.2.3	Silicate glasses	259
5.7.2.3.0	General remarks	259
5.7.2.3.1	Mn - aluminosilicate glasses	259
5.7.2.3.2	Mixed-valence Fe - silicate glasses	261
5.7.2.3.3	Ferrous - silicate glasses	263
5.7.2.3.4	Co - aluminosilicate glasses	264
5.7.3	Amorphous oxides prepared by various techniques	267
5.7.3.1	Amorphous 3d oxides	267
5.7.3.1.0	General remarks	267
5.7.3.1.1	Cr - oxides	267
5.7.3.1.2	Fe (ferric) - oxides	267
5.7.3.2	Mixed binary oxides	269
5.7.3.2.0	General remarks	269
5.7.3.2.1	Amorphous garnets	270
5.7.3.2.2	Other mixed oxides	275
5.7.3.2.2.1	ZnFe ₂ O ₄	275
5.7.3.2.2.2	Fe _{0.69} Ga _{1.37} O ₃	276
5.7.3.2.2.3	(Fe ₂ O ₃) _x (SrO) _{1-x}	278
5.7.3.2.2.4	(Fe ₂ O ₃) _x (Bi ₂ O ₃) _{1-x}	279
5.7.3.2.2.5	CoFe ₂ O ₄	281
5.7.3.2.2.6	CuFe ₂ O ₄	282
5.7.3.2.2.7	Bi ₂ CuO ₄	284
5.7.3.3	Fe ₂ O ₃ - Bi ₂ O ₃ - based ternary oxides	285
5.7.3.3.0	General remarks	285
5.7.3.3.1	Fe ₂ O ₃ · Li ₂ O · Bi ₂ O ₃ oxides	286
5.7.3.3.2	Fe ₂ O ₃ · K ₂ O · Bi ₂ O ₃ oxides	289
5.7.3.3.3	Fe ₂ O ₃ · CaO · Bi ₂ O ₃ oxides	290
5.7.3.3.4	Fe ₂ O ₃ · ZnO · Bi ₂ O ₃ oxides	295

5.7.3.3.5	$\text{Fe}_2\text{O}_3 \cdot \text{CuO} \cdot \text{Bi}_2\text{O}_3$ oxides	301
5.7.3.3.6	$\text{Fe}_2\text{O}_3 \cdot \text{Bi}_2\text{O}_3 \cdot \text{ABO}_3$ oxides	307
5.7.4	Theoretical status	315
5.7.5	References for 5.7	317

Subvolume G: Various other oxides

6	Magnetic properties of oxides with various other structures	1
6.1	Binary oxides of d transition elements (M. S. SEEHRA, H. P. J. WIJN)	1
6.1.1	Introduction	1
6.1.1.1	Scope of the review	1
6.1.1.2	Earlier reviews	1
6.1.1.3	Symbols and abbreviations	2
6.1.2	Monoxides of 3d transition elements	4
6.1.2.1	Simple monoxides MO	4
	References for 6.1.2.1	26
6.1.2.2	Mixed monoxides $\text{M}^{\text{I}}_{1-p}\text{M}^{\text{II}}_p\text{O}$	30
	References for 6.1.2.2	31
6.1.2.3	Diluted monoxides $\text{M}_p\text{N}_{1-p}\text{O}$	31
	References for 6.1.2.3	37
6.1.2.4	Electronic structures	37
6.1.3	Dioxides of 3d transition elements	38
6.1.3.1	Simple dioxides MO_2	38
6.1.3.2	Pseudo binary vanadium dioxides $\text{V}_{1-x}\text{M}_x\text{O}_2$	44
	References for 6.1.3	60
6.1.4	Intermediate phase binary oxides	62
6.1.4.1	Magnéli phases $\text{M}_n\text{O}_{2n-1}$	62
6.1.4.2	The vanadium compounds $\text{V}_n\text{O}_{2n+1}$	65
	References for 6.1.4	69
6.1.5	Oxides of 4d and 5d transition elements	71
	References of 6.1.5	84
6.2	Oxides with trirutile and pyrochlore structure (J. E. GREEDAN)	87
6.2.0	Introduction	87
6.2.1	Trirutile structure oxides	88
6.2.1.1	Crystal structure and crystallographic data	88
6.2.1.2	Magnetic properties	89
6.2.1.2.1	$\text{A}^{6+}\text{B}_2^{3+}\text{O}_6$	90
6.2.1.2.2	$\text{A}^{2+}\text{B}_2^{5+}\text{O}_6$	94
6.2.1.3	References for 6.2.1	99
6.2.2	Pyrochlore structure oxides	100
6.2.2.1	Crystal structure	100
6.2.2.1.1	Space group and atomic positions	100
6.2.2.1.2	B_2O_6 network	100
6.2.2.1.3	$\text{A}_2\text{O}'$ network	101

6.2.2.1.4	Magnetic sublattices	102
6.2.2.2	Magnetic properties	103
6.2.2.2.1	$A_2^{3+}B_2^{4+}O_6O'$ pyrochlores	103
6.2.2.2.2	$A_2^{3+}BB'O_7$ pyrochlores	118
6.2.2.2.3	$(AA')(BB')O_7$	121
6.2.2.2.4	$A_2^{2+}B_2^{5+}O_7$ pyrochlores	121
6.2.2.2.5	$(AA')^{2+}(BB')^{5+}O_7$	121
6.2.2.3	References for 6.2.2	122
6.3	Hexagonal ferrites (G. ALBANESE, A. DERIU)	124
6.3.1	Introduction	124
6.3.1.1	General remarks	124
6.3.1.2	Quantities and units.	124
6.3.1.3	List of symbols and abbreviations	128
6.3.2	Chemical compositions and phase diagrams of hexagonal ferrites	130
6.3.3	Crystal structures of hexagonal ferrites	130
6.3.4	M(magnetoplumbite)-type ferrites	131
6.3.4.1	Reviewed compositions	131
6.3.4.2	Intrinsic magnetic properties and crystalline structure	136
6.3.4.3	Extrinsic magnetic properties and microstructure	147
6.3.4.4	Phase formation and morphology studies	156
6.3.4.5	Electric and dielectric properties	162
6.3.4.6	High frequency magnetic properties	165
6.3.4.7	Optical properties	168
6.3.5	W-type ferrites	172
6.3.5.1	Reviewed compositions	172
6.3.5.2	Intrinsic magnetic properties and crystalline structure	173
6.3.5.3	Extrinsic magnetic properties and microstructure	182
6.3.5.4	Phase formation and morphology studies	183
6.3.5.5	Electric and dielectric properties	185
6.3.5.6	High frequency magnetic properties	185
6.3.5.7	Optical properties	186
6.3.6	Y-type ferrites	187
6.3.6.1	Reviewed compositions	187
6.3.6.2	Intrinsic magnetic properties and crystalline structure	188
6.3.6.3	Extrinsic magnetic properties and microstructure	191
6.3.6.4	Phase formation and morphology studies	191
6.3.6.5	Electric and dielectric properties	192
6.3.6.6	High frequency magnetic properties	192
6.3.6.7	Optical properties	194
6.3.7	Z-type ferrites	194
6.3.7.1	Reviewed compositions	194
6.3.7.2	Intrinsic magnetic properties and crystalline structure	194
6.3.7.3	Phase formation and morphology studies	195
6.3.7.4	High frequency magnetic properties	195
6.3.7.5	Optical properties	196
6.3.8	X-type ferrites	197
6.3.8.1	Reviewed compositions	197
6.3.8.2	Intrinsic magnetic properties and crystalline structure	197
6.3.8.3	Phase formation and morphology studies.	198
6.3.9	Further compositions	199

6.3.10	Microwave device applications of hexagonal ferrites	207
6.3.11	Magnetic recording applications of hexagonal ferrites	209
6.3.12	References for 6.3	216
6.4	RFe ₂ O ₄ compounds (K. SIRATORI)	225
6.4.1	Introduction	225
6.4.2	General background and scope	226
6.4.3	Exchange coupling constants estimated from the data in the paramagnetic region	227
6.4.4	The Verwey transition	229
6.4.5	Magnetization in the state of 2-dimensional spin order	231
6.4.6	Relaxation	237
6.4.7	References for 6.4	238

Subvolume H: Boron containing oxides

7	Magnetic properties of crystalline and vitreous boron containing oxide systems	1
7.0	Introduction (E. BURZO)	1
7.0.1	General remarks	1
7.0.2	List of frequently used symbols and abbreviations	1
7.1	Crystalline boron containing oxide compounds (E. BURZO)	6
7.1.1	FeBO ₃ and other MBO ₃ -based compounds (M = 3d or 4f element)	6
7.1.1.0	Introduction	6
7.1.1.1	Preparation. Crystal structures	7
7.1.1.2	Magnetization and magnetic susceptibility	13
7.1.1.3	Magnetic structure	18
7.1.1.4	Hyperfine parameters determined by nuclear gamma resonance method	18
7.1.1.5	Antiferromagnetic resonance (AFMR). Magnetostatic modes. Spin waves	25
7.1.1.6	Electron paramagnetic resonance data	34
7.1.1.7	Magnetic properties as determined by nuclear magnetic resonance method	34
7.1.1.8	Anisotropy	40
7.1.1.9	Magnetoelastic properties. Magnetostriction	41
7.1.1.10	Magneto-optical and optical properties	43
7.1.1.11	Photomagnetic effects	50
7.1.1.12	Surface magnetism (with an introduction on domain structure)	53
7.1.1.13	References for 7.1.1	58
7.1.2	Fe ₃ BO ₆ -based compounds	65
7.1.2.0	Introduction	65
7.1.2.1	Crystal structure and lattice parameters	67
7.1.2.2	Magnetization and magnetic susceptibility	68
7.1.2.3	Magnetic structure	71
7.1.2.4	Hyperfine parameters	73
7.1.2.5	Data obtained by antiferromagnetic resonance	77
7.1.2.6	Magneto-optical and optical properties	78
7.1.2.7	References for 7.1.2	80

7.1.3	Boron ferrites and related compounds	82
7.1.3.0	Introduction	82
7.1.3.1	Crystal structures. Lattice parameters	84
7.1.3.2	Magnetization and magnetic susceptibility	88
7.1.3.3	Neutron data	90
7.1.3.4	Nuclear gamma resonance data	91
7.1.3.5	Heat capacity	94
7.1.3.6	Infrared properties	94
7.1.3.7	References for 7.1.3	95
7.1.4	Miscellaneous boron containing oxide compounds	96
7.1.4.0	Introduction	96
7.1.4.1	Crystal structures. Lattice parameters	98
7.1.4.2	Magnetic properties	114
7.1.4.3	Magnetic structure	116
7.1.4.4	Local structure as determined by NMR method	117
7.1.4.5	Electron paramagnetic resonance data	118
7.1.4.6	Resistive properties	119
7.1.4.7	Optical properties	119
7.1.4.8	References for 7.1.4	123
7.2	Boracites $M_3B_7O_{13}X$ and related compounds (E. BURZO)	128
7.2.1	Preparation. Crystal structures	128
7.2.2	Magnetization and magnetic susceptibility	148
7.2.3	Magnetic structure	152
7.2.4	Hyperfine parameters as determined from nuclear gamma resonance studies	156
7.2.5	Nuclear magnetic resonance (NMR) data	160
7.2.6	Electron paramagnetic resonance data	161
7.2.7	Heat capacity	165
7.2.8	Resistivity data	168
7.2.9	Dielectric and related properties	169
7.2.10	Magnetoelectric properties	174
7.2.11	Elastic and magnetoelastic properties	181
7.2.12	Optical properties	181
7.2.13	References for 7.2	198
7.3	Boron glasses (E. BURZO)	205
7.3.0	Introduction	205
7.3.1	Structure of glasses (X-ray and neutron diffraction)	206
7.3.2	Local structure of glasses as determined by nuclear magnetic resonance	213
7.3.3	Thermal expansion	219
7.3.4	Magnetization. Magnetic susceptibility	222
7.3.5	Hyperfine parameters as determined by nuclear gamma resonance	229
7.3.6	Glass properties determined from electron paramagnetic resonance studies	240
7.3.7	Resistive and dielectric properties	245
7.3.8	Heat capacity	256
7.3.9	Optical properties	258
7.3.10	Electron spectroscopy	266
7.3.11	References for 7.3	267

Subvolume I: Silicates and phosphates (in preparation)**Subvolume J1: Halides I**

9	Magnetic properties of halides.	1
9.1	MX_2 and $\text{MX}_2 \cdot n\text{H}_2\text{O}$ compounds ($M = 3d$ element, $X =$ halogen element) (K. KATSUMATA)	1
9.1.1	Introduction	1
9.1.1.1	General remarks	1
9.1.1.2	List of frequently used symbols and abbreviations	2
9.1.2	Macroscopic magnetic and related properties of MX_2 compounds	4
9.1.2.1	MF_2 compounds	4
9.1.2.2	MCl_2 compounds	13
9.1.2.3	MBr_2 compounds	20
9.1.2.4	MI_2 compounds	25
9.1.3	Macroscopic magnetic and related properties of $\text{MX}_2 \cdot n\text{H}_2\text{O}$ compounds	28
9.1.4	Microscopic magnetic and related properties of MX_2 and $\text{MX}_2 \cdot n\text{H}_2\text{O}$ compounds	47
9.1.4.1	MX_2 compounds	47
9.1.4.2	$\text{MX}_2 \cdot n\text{H}_2\text{O}$ compounds	54
9.1.5	References for 9.1	56
9.2	$\text{M}_{1-x}\text{M}'_x\text{X}_2$ and $\text{M}_{1-x}\text{M}'_x\text{X}_2 \cdot n\text{H}_2\text{O}$ compounds ($M, M' = 3d$ element, $X =$ halogen element) (K. KATSUMATA)	59
9.2.1	Introduction	59
9.2.1.1	General remarks	59
9.2.1.2	List of frequently used symbols and abbreviations	60
9.2.2	Static magnetic and related properties of $\text{M}_{1-x}\text{M}'_x\text{X}_2$ and $\text{M}_{1-x}\text{M}'_x\text{X}_2 \cdot n\text{H}_2\text{O}$ compounds	61
9.2.2.1	Static magnetic and related properties of $\text{M}_{1-x}\text{M}'_x\text{F}_2$ compounds	61
9.2.2.2	Static magnetic and related properties of $\text{M}_{1-x}\text{M}'_x\text{Cl}_2$ compounds	72
9.2.2.3	Static magnetic and related properties of $\text{Fe}_{1-x}\text{Co}_x\text{Br}_2$ compound	88
9.2.2.4	Static magnetic and related properties of $\text{M}_{1-x}\text{M}'_x\text{X}_2 \cdot n\text{H}_2\text{O}$ compounds	92
9.2.3	Dynamical magnetic and related properties of $\text{M}_{1-x}\text{M}'_x\text{X}_2$ and $\text{M}_{1-x}\text{M}'_x\text{X}_2 \cdot n\text{H}_2\text{O}$ compounds	103
9.2.3.1	Dynamical magnetic and related properties of $\text{M}_{1-x}\text{M}'_x\text{F}_2$ compounds	103
9.2.3.2	Dynamical magnetic and related properties of $\text{M}_{1-x}\text{M}'_x\text{Cl}_2$ compounds	104
9.2.3.3	Dynamical magnetic and related properties of $\text{Fe}_{1-x}\text{Co}_x\text{Br}_2$ compound	110
9.2.3.4	Dynamical magnetic and related properties of $\text{Fe}_{1-x}\text{Co}_x\text{Cl}_2 \cdot 2\text{H}_2\text{O}$ compound	111
9.2.4	References for 9.2	112

9.3	MX ₃ compounds (M = 3d element, X = halogen element) (K. KATSUMATA)	114
9.3.1	Introduction	114
9.3.1.1	General remarks	114
9.3.1.2	List of frequently used symbols and abbreviations	114
9.3.2	Macroscopic magnetic and related properties of MX ₃ compounds	116
9.3.2.1	MF ₃ compounds	117
9.3.2.2	MCl ₃ compounds	121
9.3.2.3	MBr ₃ compounds	128
9.3.2.4	MI ₃ compounds	130
9.3.3	Microscopic magnetic and related properties of CrX ₃ compounds	132
9.3.4	References for 9.3	134
9.4	MCl ₂ -GIC; MCl ₃ -GIC (M = 3d element) (M. MATSUURA, M. HAGIWARA)	136
9.4.1	Introduction	136
9.4.1.1	General remarks	136
9.4.1.2	List of frequently used symbols	140
9.4.1.3	List of abbreviations	142
9.4.2	Singly intercalated compounds	144
9.4.2.1	General survey	144
9.4.2.2	CoCl ₂ -GIC	148
9.4.2.2.1	Stage 2 CoCl ₂ -GIC	148
9.4.2.2.2	Stage n CoCl ₂ -GIC (n≥3)	159
9.4.2.2.3	Stage 1 CoCl ₂ -GIC	160
9.4.2.3	NiCl ₂ -GIC	163
9.4.2.3.1	Stage 2 NiCl ₂ -GIC	163
9.4.2.3.2	Stage n NiCl ₂ -GIC (n≥3)	168
9.4.2.3.3	Stage 1 NiCl ₂ -GIC	168
9.4.2.4	MCl ₂ -GIC (M = Mn, Cu)	170
9.4.2.4.1	Stage n MnCl ₂ -GIC	170
9.4.2.4.2	Stage n CuCl ₂ -GIC	175
9.4.2.5	MCl ₃ -GIC (M = Cr, Fe)	176
9.4.2.5.1	Stage n CrCl ₃ -GIC	176
9.4.2.5.2	Stage 1 FeCl ₃ -GIC	179
9.4.2.5.3	Stage n FeCl ₃ -GIC (n≥2)	182
9.4.3	Bi-intercalation compounds	184
9.4.3.1	General survey	184
9.4.3.2	M'(magnetic)Cl _n -M''(nonmagnetic)Cl _m -GBIC (M' = Co, Cr, M'' = Al, Ga, Cd)	186
9.4.3.2.1	CoCl ₂ -GaCl ₃ -GBIC	186
9.4.3.2.2	CoCl ₂ -AlCl ₃ -GBIC	186
9.4.3.2.3	CrCl ₃ -AlCl ₃ -GBIC	186
9.4.3.2.4	CrCl ₃ -CdCl ₂ -GBIC	186
9.4.3.3	M'(magnetic)Cl _n -M''(magnetic)Cl _m -GBIC (M', M'' = Cr, Mn, Fe, Co, Ni)	188
9.4.3.3.1	CoCl ₂ -FeCl ₃ -GBIC	188
9.4.3.3.2	NiCl ₂ -FeCl ₃ -GBIC	189

9.4.3.3.3	NiCl ₂ -CrCl ₃ -GBIC	191
9.4.3.3.4	MnCl ₂ -CrCl ₃ -GBIC	193
9.4.4	Mixed intercalation compounds	193
9.4.4.1	General survey	193
9.4.4.2	Mixed compounds	194
9.4.4.2.1	Co _{1-x} Ni _x Cl ₂ -GIC	194
9.4.4.2.2	Co _{1-x} Mn _x Cl ₂ -GIC	196
9.4.4.2.3	Co _{1-x} Fe _x Cl ₂ -GIC	198
9.4.4.3	Diluted compounds	198
9.4.4.3.1	Co _{1-x} Al _x Cl ₂ -GIC	198
9.4.4.3.2	Co _{1-x} Mg _x Cl ₂ -GIC	199
9.4.5	References for 9.4	201
9.5	MM'F ₅ and MM'F ₅ · nH ₂ O compounds (M, M' = 3d element or Al; n = 2 or 7) (H.P.J. WILN)	206
9.5.1	List of symbols and abbreviations	206
9.5.2	MM'F ₅ compounds	206
9.5.3	MM'F ₅ · 2H ₂ O compounds	213
9.5.3.1	Crystal structure	213
9.5.3.2	Magnetic structures	214
9.5.3.3	Mössbauer data	217
9.5.3.4	Magnetization curves	222
9.5.3.5	Paramagnetic properties	224
9.5.4	MM'F ₅ · 7H ₂ O compounds	226
9.5.5	References for 9.5	232

Subvolume J2: Halides II

9.6	AMX ₃ and AMX ₃ · 2H ₂ O compounds (A, M = metal, X = halogen element) (A. CHELKOWSKI)	1
9.6.0	Introduction	1
9.6.0.1	General remarks	1
9.6.0.2	List of frequently used symbols and abbreviations	2
9.6.1	Table	7
9.6.2	Figures	56
9.6.3	References for 9.6 and 9.9	247
9.7	AMF ₄ and AMF ₄ · H ₂ O compounds (A = alkali element, Tl or NH ₄ , M = 3d element) (H.P.J. WILN)	259
9.7.1	AMF ₄ compounds	259
9.7.2	AMF ₄ · H ₂ O compounds	275
9.7.3	References for 9.7	280

9.8	A_2MX_5 and $A_2MX_5 \cdot H_2O$ compounds ($A = Li, Na, K, Rb, Cs, Tl, NH_4$; $M = 3d$ element; $X = F, Cl, Br$) (A. CHELKOWSKI, H.P.J. WIJN)	282
9.8.1	Introduction	282
9.8.2	A_2MX_5 compounds	282
9.8.2.1	Crystallographic properties of A_2MX_5 compounds	282
9.8.2.2	Magnetic properties of A_2MF_5 compounds	284
9.8.3	$A_2MX_5 \cdot H_2O$ compounds	296
9.8.3.1	Crystallographic properties of $A_2MX_5 \cdot H_2O$ compounds	296
9.8.3.2	Magnetic properties of $A_2MX_5 \cdot H_2O$ compounds	296
9.8.4	References for 9.8	318
9.9	$A_2MM'X_6$ compounds ($A, M, M' = \text{metal}$, $X = \text{halogen element}$) (A. CHELKOWSKI)	321
9.9.0	Introduction	321
9.9.1	Table	322
9.9.2	Figures	326
9.10	$A_2M^{2+}M^{3+}F_7$ compounds ($A = Na, Ag$; $M = 3d$ element, Mg, Al or In) (H.P.J. WIJN)	337
9.10.1	Introduction	337
9.10.2	Crystallographic properties of $A_2M^{2+}M^{3+}F_7$ compounds	337
9.10.3	Magnetic properties of $A_2M^{2+}M^{3+}F_7$ compounds	340
9.10.4	References for 9.10	350
9.11	$A_5M_3F_{14}$ compounds ($A = Na, K$ or Ag ; $M = 3d$ element or Al) (H.P.J. WIJN)	351
9.11.1	Crystallographic properties of $A_5M_3F_{14}$ compounds	351
9.11.2	Magnetic properties of $A_5M_3F_{14}$ compounds	352
9.11.3	References for 9.11	359

Subvolume J3: Halide perovskite-type layer structures

9.12	Halide perovskite-type layer structures (R. GEICK)	1
9.12.1	Introduction	1
9.12.1.1	Characterization of perovskite-type Layer structures	1
9.12.1.2	Lattice dynamics: intralayer and interlayer forces	4
9.12.1.3	Comments on notation and units and Table 1	9
9.12.1.4	References for 9.12.1	40
9.12.2	Structural properties	43
9.12.2.1	Structures	43
9.12.2.1.1	General aspects	43
9.12.2.1.2	Easy-axis antiferromagnets	45
9.12.2.1.3	Easy-plane ferromagnets and antiferromagnets	47

9.12.2.1.4	Structures resulting from structural phase transitions	49
9.12.2.1.5	Mixed crystals	52
9.12.2.2	Structural phase transitions	54
9.12.2.2.1	Experimental investigations	54
9.12.2.2.2	Group-theoretical considerations	61
9.12.2.2.3	Structural phase transitions in monoammonium compounds	65
9.12.2.2.4	Model for the phase transitions in monoammonium compounds	68
9.12.2.2.5	Long-chain compounds	73
9.12.2.2.6	Diammonium compounds	74
9.12.2.3	Figures for 9.12.2 and Tables 2, 3 and 4	78
9.12.2.4	References for 9.12.2	148
9.12.3	Magnetic properties	159
9.12.3.1	Antiferromagnets	159
9.12.3.1.1	Exchange interaction	159
9.12.3.1.2	Mn-compounds, spin-wave theory	160
9.12.3.1.3	Temperature-dependent properties, high temperature series	167
9.12.3.1.4	Double-layer compounds	171
9.12.3.1.5	Ni- and Fe-compounds	172
9.12.3.1.6	Spin-flop transition – AFMR under various conditions	175
9.12.3.1.7	Canted antiferromagnets, weak ferromagnetism	181
9.12.3.1.8	Antiferromagnetic Cu-compounds	184
9.12.3.1.9	Co-compounds (2D Ising Model)	186
9.12.3.2	Ferromagnets	188
9.12.3.2.1	Cu-compounds	188
9.12.3.2.2	Cr-compounds	195
9.12.3.2.3	Spin-reorientation transitions – FMR under various conditions	201
9.12.3.2.4	Magnetic polaritons	208
9.12.3.2.5	Parallel pumping experiments	210
9.12.3.3	Doped and mixed systems	213
9.12.3.3.1	Paramagnetic centres in diamagnetic host crystals	213
9.12.3.3.2	Magnetic ordering in diluted systems	216
9.12.3.3.3	Spin waves in diluted magnets	222
9.12.3.3.4	Excitations in mixed antiferromagnets	227
9.12.3.3.5	Mixed antiferromagnets with competing anisotropies	233
9.12.3.3.6	Mixed magnets with competing exchange interactions	236
9.12.3.4	Figures for 9.12.3 and Table 5	243
9.12.3.5	References for 9.12.3	328
9.12.4	Critical phenomena	349
9.12.4.1	Static critical behaviour	349
9.12.4.1.1	General	349
9.12.4.1.2	2D Ising Model	351
9.12.4.1.3	Experimental determination of α	354
9.12.4.1.4	Experimental determination of β	356
9.12.4.1.5	Experimental determination of γ , ν and η	357

9.12.4.1.6	Experimental test of the two-scale-factor universality	360
9.12.4.1.7	2D Heisenberg model	361
9.12.4.1.8	2D XY-model	364
9.12.4.1.9	Crossover phenomena	376
9.12.4.1.10	3D XY-model – structural phase transitions	379
9.12.4.1.11	Critical behaviour near the percolation threshold	382
9.12.4.1.12	Random field effects – random field Ising model	391
9.12.4.1.13	Critical properties of spin glasses – 2D Ising spin glass	398
9.12.4.2	Dynamic critical properties and relaxation	402
9.12.4.2.1	Characteristic frequency from neutron inelastic scattering	402
9.12.4.2.2	Relaxation time – activated dynamics – aging	403
9.12.4.2.3	Spin-wave lineshape of a 2D Heisenberg ferromagnet	409
9.12.4.2.4	2D XY-model: influence of vortices on $S(\mathbf{q}, \omega)$	411
9.12.4.2.5	Critical broadening of the NMR linewidth	413
9.12.4.2.6	Critical broadening of the EPR linewidth	414
9.12.4.2.7	Critical EPR linewidth due to solitons or due to magnons?	417
9.12.4.2.8	EPR linewidth at high temperatures – spin diffusion	420
9.12.4.2.9	EPR linewidth in mixed crystals	423
9.12.4.3	Figures for 9.12.4 and Table 6	427
9.12.4.4	References for 9.12.4	485
	Contents of further subvolumes of III/27	504
	List of editor and authors of Vol. III/27	530

List of editor and authors of Vol. III/27

Editor

H. P. J. Wijn, Institut für Werkstoffe der Elektrotechnik der Rheinisch-Westfälischen Technischen Hochschule Aachen, Templergraben, 52062 Aachen, FRG

Authors

K. Adachi, Department of Physics, Nagoya University, Nagoya 464, Japan (27 A)

E. Agostinelli, Istituto di Teoria e Struttura Elettronica - CNR, Via Salaria, 00016 Monterotondo Stazione (Roma), Italy (27 D)

G. Albanese, Dipartimento di Fisica, Università degli Studi di Parma, Viale delle Scienze, I-43100 Parma, Italy (27 G)

V. A. M. Brabers, Technische Universiteit Eindhoven, Den Dolech, 5600 MB Eindhoven, The Netherlands (27 D)

E. Burzo, Universitatea Babes Bolyai, Facultatea de Fizica, 3400 Cluj-Napoca, Romania (27 H, 27 F1 α , 27 F1 β)

A. Chelkowski, Institute of Physics, Silesian University, 40-007 Katowice, Poland (27 J2)

A. Deriu, Dipartimento di Fisica, Università degli Studi di Parma, Viale delle Scienze, I-43100 Parma, Italy (27 G)

Y. Endoh, Neutron Scattering Laboratory, Department of Physics, Tohoku University, Aramaki, Aoba-ku, Sendai 980, Japan (27 F3)

D. Fiorani, Istituto di Teoria e Struttura Elettronica - CNR, Via Salaria, 00016 Monterotondo Stazione (Roma), Italy (27 D)

R. Geick, Physikalisches Institut der Universität Würzburg, Am Hubland, 97074 Würzburg, FRG (27 J3)

J. E. Greedan, Institute for Material Research, McMaster University, Main Street West, Hamilton, Ontario L8S, 4M1, Canada (27 G)

M. Hagiwara, Department of Electronics and Information Science, Kyoto Institute of Technology, Matsugasaki, Kyoto 606, Japan (27 J1)

D. Kaczorowski, Polish Academy of Sciences, W. Trzebiatowski Institute of Low Temperature and Structure Research, 50-950 Wrocław 2, Poland (27 B8, 27 C2)

K. Kakurai, Neutron Scattering Facility, Institute for Solid State Physics, University of Tokyo, Tokai mura, Ibaraki 319-11, Japan (27 F3)

A. K. Katori, Institute for Solid State Physics, University of Tokyo, Roppongi, Minato-ku, Tokyo 107, Japan (27 F3)

K. Katsumata, Institute of Physical and Chemical Research (RIKEN), Wako, Saitama, 351-01, Japan (27 J1)

Z.A. Kazei, Department of Physics (DFEF), Problem Laboratory for Magnetism, Moscow State University, Leninskiye Gory, 119899 Moscow, Russia (27 E, 27 F2, 27 F2S)

- N. P. Kolmakova**, Department of Physics (DFEF), Problem Laboratory for Magnetism, Moscow State University, Leninskiye Gory, 119899 Moscow, Russia **(27 E)**
- I. B. Krynetskii**, Department of Physics (DFEF), Laboratory for Problems of Magnetism, Moscow State University, Leninskiye Gory, 119899 Moscow, Russia **(27 F2, 27 F2S)**
- M. Matsuura**, Department of Electronics and Information Science, Kyoto Institute of Technology, Matsugasaki Sakyo-ku, Kyoto 606, Japan **(27 J1)**
- P. Novák**, Institute of Physics, Czechoslovak Academy of Sciences, Na Slovance, 18040 Prague 8, Czechoslovakia **(27 E)**
- S. Ogawa**, Institute of Solid State Physics, Tokyo University, Roppongi, Minato-ku, Tokyo, Japan **(27 A)**
- T. Palewski**, International Laboratory of High Magnetic Fields and Low Temperatures, 53-421 Wrocław, Poland **(27 B1, 27 B2, 27 B3, 27 B4 α , 27 B4 β , 27B5, 27 C1)**
- M. S. Seehra**, Phys. Dept., West Virginia University, Morgantown WV 26506, USA **(27 G, 27 F3)**
- K. Siratori**, Dept. of Physics, Faculty of Science, Osaka University, Toyonaka, Osaka 560, Japan **(27 G)**
- G. Srinivasan**, Department of Physics, Oakland University, Rochester, Michigan 48309 - 4401, USA **(27 F3)**
- V. I. Sokolov**, Department of Physics (DFEF), Problem Laboratory for Magnetism, Moscow State University, Leninskiye Gory, 119899 Moscow, Russia **(27 E)**
- W. Suski**, Polish Academy of Sciences, W. Trzebiatowski Institute of Low Temperature and Structure Research, 50-950 Wrocław 2, and International Laboratory of High Magnetic Fields and Low Temperatures, 53-421 Wrocław, Poland **(27 B1, 27 B2, 27 B3, 27 B4 α , 27 B4 β , 27B5, 27 C1)**
- A.M. Testa**, Istituto di Teoria e Struttura Elettronica - CNR, Via Salaria, 00016 Monterotondo Stazione (Roma), Italy **(27 D)**
- R. Troć**, Polish Academy of Sciences, W. Trzebiatowski Institute of Low Temperature and Structure Research, 50-950 Wrocław 2, Poland **(27 C2)**
- T. E. Whall**, Department of Physics, University of Warwick, Coventry CV4-7AL, United Kingdom **(27 D)**
- H. P. J. Wijn**, Institut für Werkstoffe der Elektrotechnik der Rheinisch-Westfälischen Technischen Hochschule Aachen, Templergraben, 52062 Aachen, FRG **(27 G, 27 J1, 27 J2)**