

Volume 19
Magnetic Properties of Metals

Subvolume G
Thin Films

	Introductory material	
5	Thin films	1
5.1	Surfaces, interfaces and ultrathin films (U. GRADMANN)	1
5.1.1	Introduction	1
5.1.1.1	General remarks	1
5.1.1.2	List of experimental and theoretical methods	1
5.1.1.3	List of other abbreviations and explanations	2
5.1.2	Magnetization at fixed temperatures	2
5.1.2.1	Surface magnetization	3
5.1.2.2	Changes of surface magnetization	8
5.1.2.3	Monolayer magnetization at fixed (low) temperatures	11
5.1.3	Magnetic hyperfine interactions at fixed temperatures	12
5.1.3.1	Surface hyperfine interactions	12
5.1.3.2	Ground state hyperfine interactions in monolayer-range films	14
5.1.4	Temperature dependence of magnetic order	15
5.1.5	Live layers	25
5.1.6	Magnetic surface anisotropies	27
5.1.7	References for 5.1	32
5.2	Crystalline films of 3d transition elements and of alloys between these elements (H.P.J. WIJN)	35
5.2.1	Introduction	35
5.2.1.1	Preparation parameters	35
5.2.1.1.1	Sputtered films	35
5.2.1.1.2	Evaporated films	35
5.2.1.2	Structure of the films	36
5.2.1.3	Formal description of the magnetic anisotropy of films	36
5.2.1.3.1	Normal incidence of the beam	36
5.2.1.3.2	Oblique incidence of the particle beam	37
5.2.2	Films obtained by sputtering	38
5.2.2.1	Films of Fe, Co and alloys between Fe, Co or Ni	38
5.2.2.2	Films of alloys of Ti, V, Cr with Fe, Co, Ni	56
5.2.3	Films obtained by evaporation	88
5.2.3.1	Fe films	88
5.2.3.2	Ni films	96
5.2.3.3	FeNi alloy films	102
5.2.3.4	Films of Co and of alloys of Co with Fe, Ni	124
5.2.4	References for 5.2	132
5.3	Crystalline and amorphous films with rare earth and 3d transition elements (P. HANSEN)	136
5.3.1	Introduction	136
5.3.1.1	General remarks	136

5.3.1.2	Material survey	136
5.3.2	Structure	137
5.3.3	Mössbauer spectroscopy	143
5.3.4	Magnetization	149
5.3.4.1	RE-TM alloys with RE = Y, La, Ce, Lu	150
5.3.4.2	RE-TM alloys for RE other than Y, La, Ce, Lu and TM other than Fe, Co, Ni	159
5.3.4.3	Gd-TM alloys	165
5.3.4.4	RE-TM alloys Re other than Y, La, Ce, Gd, Lu with primarily TM = Fe, Co, Ni	182
5.3.5	Exchange constants	203
5.3.6	Magnetic anisotropy	205
5.3.6.1	Crystalline compounds	206
5.3.6.2	Amorphous alloys	209
5.3.7	Magnetostriction	222
5.3.7.1	Crystalline compounds	222
5.3.7.2	Amorphous alloys	226
5.3.8	Coercivity	229
5.3.9	Bubble parameters and domain investigations	235
5.3.10	Ferromagnetic resonance (FMR) and spin waves	242
5.3.11	Magneto-optical properties	248
5.3.11.1	Faraday rotation	248
5.3.11.2	Kerr rotation	253
5.3.12	Magnetoresistivity and Hall effect	264
5.3.12.1	Magnetoresistivity	264
5.3.12.2	Hall effect	268
5.3.13	References for 5.3	276
5.4	Thin film sandwiches (Y. ENDOH, T. SHINJO, N. HOSOITO)	288
5.4.1	General remarks	288
5.4.2	Survey of multilayered films	290
5.4.3	Magnetic properties	294
5.4.3.1	Non-Fe superlattice films	294
5.4.3.2	Fe-based superlattice films	307
5.4.4	References for 5.4	321