

List of Figures

1.1	Slater-Pauling curve for an Fe-Ni alloy	7
1.2	Local magnetic moments on Fe and Ni sites for an Fe-Ni alloy	8
1.3	Local intermixing at the Fe/Ni interface assuming fcc growth	9
1.4	Stability diagram of the easy axis of the magnetization	11
1.5	Different types of spin-reorientation transitions	12
1.6	Magnetic phase diagram of Fe/Cu(100) as a function of the film thickness . . .	16
1.7	Magnetic phase diagram of Ni/Cu(001) as a function of the film thickness . . .	18
1.8	Equilibrium number of magnetic moments within a domain wall of a bulk-like Fe/Cu(100) film	22
1.9	Rotation of the magnetization within a Bloch and a Néel wall	23
1.10	Cross section through a Bloch and a Néel wall in thin films	24
1.11	Zigzag-shaped charged domain wall between two domains meeting “head-on” .	25
1.12	Profile of a perpendicularly magnetized stripe domain state of a monolayer . . .	26
1.13	Magnetic phase diagram of a thin film at $T = 0$ in the $(K_2 - K_4)$ plane	27
2.1	Band structure of Co and the asymmetry oscillation as a function of the electron energy	30
2.2	Schematic arrangement of the spin manipulator of the SPLEEM	31
2.3	Electron optical schematic diagram of the SPLEEM	32
2.4	Sketch of the detection system of the SPLEEM	33
2.5	Mechanisms of the LEEM phase contrast	34
2.6	Spin-selective excitation from the spin-orbit split $2p_{3/2,1/2}$ core shell to the ex- change split $3d$ band	38
2.7	Isotropic absorption and XMCD spectra and the corresponding integrals of Fe ₄ /Ni ₁₇ /Cu(100)	40
2.8	Schematic of an rf-SQUID loop and the V-I-characteristics	43
2.9	Coordinates and vectors used to calculate the stray field integrals	44
2.10	Calculated stray field distribution of an in-plane and an out-of-plane magnetized Fe film	45

3.1	LEEM image of the bare Cu(100) surface and the corresponding step edge profile	48
3.2	Auger spectrum of the bare Cu(100) crystal	49
3.3	Oscillation of the average LEEM intensity versus time during Ni deposition . .	50
3.4	Auger spectrum of a 4 ML Fe/Cu(100) film	51
3.5	LEED images of the bare Cu(100) crystal and a 4 ML Fe/Cu(100) film	51
3.6	LEED image of the bare GaAs(001) substrate	52
4.1	UHV-SQUID setup.	54
4.2	Construction and electrical connections of the sample holder	56
4.3	Evaporation of ferromagnetic films of $3 \times 3 \text{ mm}^2$ by means of an aperture plate	57
4.4	Calibration of the SQUID sensor signal by means of a small coil	58
4.5	Measured stray field component B_z of a 12.5 ML Fe/GaAs(001) film	60
5.1	Onset of ferromagnetic order within the plane of a Ni/Cu(100) film at 300 K . .	61
5.2	Magnetic contrast versus the Ni layer thickness	62
5.3	Large “head-on” domains in 4.8 ML Ni/Cu(100) at 100 K	64
5.4	Domain wall width of in-plane magnetized Ni/Cu(100) versus the thickness . .	65
5.5	Angular dependent investigation of magnetic domains of an 8 ML Ni/Cu(100) film at 300 K	66
5.6	Néel wall profile of an 8 ML Ni/Cu(100) film	69
5.7	Evolution of magnetic domains of an ultrathin Fe/Cu(100) film as a function of the thickness	71
5.8	Profiles of perpendicularly magnetized stripe domains of Fe/Cu(100) films . . .	72
5.9	Evolution and size of out-of-plane magnetized domains of two different Fe/Ni/Cu(100) films	74
5.10	Broadening of perpendicularly magnetized domains of 7.5 ML Ni/Cu(100) upon Fe deposition	75
5.11	Imaging of Bloch walls of an $\text{Fe}_{0.7}/\text{Ni}_{11}/\text{Cu}(100)$ film	76
5.12	Evolution of Bloch walls of an $\text{Fe}_x/\text{Ni}_{11}/\text{Cu}(100)$ film as a function of the Fe layer thickness	77
5.13	In-plane magnetized $\text{Fe}_{2.8}/\text{Ni}_{7.5}/\text{Cu}(100)$ film at 300 K	78
6.1	Spin-reorientation transition of Ni/Cu(100) at 300 K as a function of the thickness	80
6.2	Domain wall profiles of a 10.2 ML Ni/Cu(100) film at the SRT	81
6.3	Spin canting at the SRT of Ni/Cu(100) as a function of the thickness at 300 K .	83
6.4	XMCD spectra of a perpendicularly magnetized $\text{Fe}_4/\text{Ni}_{17}/\text{Cu}(100)$ film at the Fe and Ni $L_{2,3}$ edges at normal photon incidence	85
6.5	XMCD spectra of an in-plane magnetized $\text{Fe}_{6.5}/\text{Ni}_{17}/\text{Cu}(100)$ film at the Fe and Ni $L_{2,3}$ edges at a grazing photon incidence of $\theta = 60^\circ$	85

6.6	Element-selective hysteresis loops taken at the L_3 edges of Fe and Ni of an $\text{Fe}_{17}/\text{Ni}_{17}/\text{Cu}(100)$ film	86
6.7	Continuous spin-reorientation transition of an $\text{Fe}_x/\text{Ni}_{11}/\text{Cu}(100)$ film as a function of the Fe thickness	90
6.8	Profile of the stripe domain pattern of an $\text{Fe}_{2.6}/\text{Ni}_{11}/\text{Cu}(100)$ film	91
6.9	Angular dependent magnetic contrast of $\text{Fe}_x/\text{Ni}_{11}/\text{Cu}(100)$ as a function of the Fe layer thickness	93
6.10	3D-plot of the angular dependence of the magnetization direction versus the Fe thickness of an $\text{Fe}_x/\text{Ni}_{11}/\text{Cu}(100)$ film	94
6.11	Model of the spiral-like SRT of Fe/Ni/Cu(100) films during the SRT	95
6.12	Angular dependence of the magnetization direction of an $\text{Fe}_x/\text{Ni}_{11}/\text{Cu}(100)$ film during the SRT	99
6.13	Domain wall evolution of an $\text{Fe}_x/\text{Ni}_7/\text{Cu}(100)$ film as a function of the Fe thickness	101
6.14	Bloch to Néel wall transition of an $\text{Fe}_x/\text{Ni}_7/\text{Cu}(100)$ film at the SRT	103
6.15	Domain formation of an $\text{Fe}_x/\text{Ni}_{1.5}/\text{Cu}(100)$ film at the SRT	105
A.1	Different views of the UHV-chamber	113
A.2	Dimensions and different views of the sample holder	114
A.3	Dimensions of the cryostat finger and the μ -metal screening	114
A.4	Dimensions of the SQUID holder	115
A.5	Control panel of the main program	116
A.6	Control panel of the program for SQUID data acquisition	117
A.7	Calibration of the Fe evaporator	118
A.8	Determination of the canting angle of the magnetization.	119

List of Tables

2.1	Domain imaging methods	35
6.1	Magnetic moments per Ni atom of an $\text{Fe}_x/\text{Ni}_{17}/\text{Cu}(100)$ film as a function of the Fe layer thickness x	88
6.2	Magnetic moments per Fe atom of an $\text{Fe}_x/\text{Ni}_{17}/\text{Cu}(100)$ film as a function of the Fe layer thickness x	88
6.3	Anisotropy constants of Ni/Cu(100) and Fe/Cu(100) at 300 K	98
A.1	Conversion of energy units	111
A.2	Lattice constants, surface and volume density of atoms and conversion constants	111
A.3	Construction of the UHV-chamber: positions and angles of the flanges	112
A.4	Technical details of the SQUID	118

