Contents

Abstract									
Κι	Kurzfassung								
Introduction									
1	Fun	damen	tals	5					
	1.1	Ferron	agnetism in ultrathin 3d bilayer films	5					
		1.1.1	Exchange coupling in bilayer systems	6					
		1.1.2	Magnetic moments at interfaces and in alloys	6					
	1.2	Spin-re	eorientation transition (SRT)	10					
		1.2.1	The role of magnetic anisotropies	10					
		1.2.2	Spin-reorientation transition of Ni/Cu(100) and Fe/Cu(100) films \ldots	13					
	1.3	Magne	tic domains	21					
		1.3.1	The thermodynamic ground state of magnetic domains	21					
		1.3.2	Domain walls in ultrathin films	21					
		1.3.3	The stripe domain state	25					
2	Experimental details								
	2.1	SPLEE	ΞΜ	29					
		2.1.1	Mode of operation	29					
		2.1.2	Comparison with other domain imaging methods	34					
	2.2	XMCI)	37					
		2.2.1	Determination of magnetic moments using "sum rules"	39					
		2.2.2	Element-specific determination of the magnetization direction in bilayers	41					
	2.3	SQUII	Omagnetometry	42					
		2.3.1	Operation of an rf-SQUID	42					
		2.3.2	Determination of magnetic moments from the stray field	43					

3	Substrate preparation and ultrathin film growth			47			
	3.1	Prepar	ation of the Cu(100) and GaAs(001) substrates	47			
	3.2	Growt	h of ultrathin Ni, Fe and Fe/Ni films on Cu(100) and GaAs(001) \ldots	49			
4	Des	Design of the UHV-SQUID system					
	4.1	Constr	uction of the UHV chamber	53			
	4.2	The SO	QUID sensor	55			
	4.3	4.3 Cryostat and magnetic shielding					
	4.4	The sa	mple holder	56			
	4.5	Calibra	ation of the SQUID	57			
	4.6	Data a	cquisition	59			
	4.7	Measu	rements of the stray field of a 12.5 ML Fe/GaAs(001) film	59			
5	Mag	Magnetic domains					
	5.1	5 to 8	ML Ni on Cu(100)	61			
		5.1.1	Comparison of domains at 100 K and 300 K	61			
		5.1.2	Analysis of a domain wall of an 8 ML Ni/Cu(100) film	65			
	5.2	2 Evolution of magnetic stripe domains in Fe/Cu(100) films					
	5.3	5.3 Fe monolayers on 7 to 11 ML Ni/Cu(100)					
		5.3.1	Out-of-plane magnetized domains (0 to 2.5 ML Fe)	73			
		5.3.2	In-plane magnetized domains (> 2.8 ML Fe)	78			
6	Mag	lagnetic domains near the spin-reorientation transition					
	6.1	Contin	nuous reorientation of the magnetization in Ni/Cu(100) films $\ldots \ldots$	79			
	6.2	2 Spin-reorientation transition of Fe/Ni bilayers on Cu(100)					
		6.2.1	Coupling between Fe and Ni layers	84			
		6.2.2	Magnetic moments per Fe and Ni atom	87			
		6.2.3	Continuous SRT as a function of the Fe layer thickness	89			
		6.2.4	Determination of the Fe-Ni interface magnetic anisotropy from the cri-				
			tical Fe layer thickness	96			
		6.2.5	Domain wall evolution near the SRT	100			
		6.2.6	SRT of $\operatorname{Fe}_x/\operatorname{Ni}_{1.5}/\operatorname{Cu}(100)$	104			
7	Conclusion						
Α	Арр	endix		111			
	A.1	Conversion of properties and units					
	A.2	Drawings of the UHV-components					
	A.3	Motor control and data acquisition program					

A.4	Technical data of the SQUID sensor	118			
A.5	Calibration of the Fe evaporator	118			
A.6	Determination of the canting angle from XMCD measurements	119			
List of Figures					
List of Tables					
References					
List of publications					
Acknowledgment					
Zusammenfassung					