



# Contents

<b>1. Introduction</b>	1
<b>2. Evanescent X-Ray Scattering</b>	6
2.1 X-Ray Optics	6
2.2 Kinematic Theory of Grazing Angle Scattering	12
2.2.1 Distorted Wave Born Approximation (DWBA)	12
2.2.2 Depth Profiles of Surface Scattering	15
2.2.3 Bragg Scattering from Real Surfaces	18
2.3 Some Applications of Grazing Angle Scattering	20
2.4 Experimental Considerations	23
2.4.1 Glancing Angle Scattering Geometry	23
2.4.2 Integrated Grazing Angle Bragg Intensity	26
2.4.3 Experimental Station	27
2.4.4 Sample Preparation and Characterization	30
<b>3. Evanescent Neutron Scattering</b>	32
3.1 Neutron Index of Refraction	32
3.2 Elementary Neutron Optics	36
3.2.1 Magnets and Superconductors	39
3.2.2 Buried Interfaces	41
3.3 Grazing Angle Neutron Scattering in DWBA	43
3.3.1 Nuclear Scattering and Surface Roughness	44
3.3.2 Magnetic Scattering	47
3.4 Scattering Experiments with Evanescent Neutrons	50
3.4.1 Asymmetric Grazing Incidence Diffraction	52
3.4.2 Grazing Angle Diffraction	54
<b>4. Semi-Infinite Critical Systems</b>	58
4.1 Order Parameter Near a Free Surface	60
4.1.1 Ferromagnetism Near the Ni(100) and EuS(111) Surfaces	60
4.1.2 Critical LRO at the Fe <sub>3</sub> Al Surface	62
4.2 Surface Induced Decay of Critical Correlations	67
4.3 The Exponent $\nu$ and Surface Scaling Relations	73
4.4 Nonideal Stoichiometry, Surface Segregation and Dirty Surfaces	75

4.5	Evanescnt Magnetic Neutron Scattering from the MnF <sub>2</sub> (001) Surface .....	79
<b>5.</b>	<b>Surface Effects at First Order Phase Transitions .....</b>	<b>82</b>
5.1	Surface Induced Disorder in Cu <sub>3</sub> Au .....	82
5.1.1	Long Range Order (LRO) at the (001) Surface .....	84
5.1.2	Evanescnt SRO Diffuse Scattering .....	94
5.1.3	Time Resolved Evanescnt Bragg Diffraction .....	97
5.2	Surface Melting .....	105
5.2.1	Criteria for Melting and Surface Melting .....	105
5.2.2	Near-Surface Crystallinity .....	110
5.2.3	Surface Sensitive X-Ray Scattering from Al and Pb ..	112
5.3	Surface Roughening .....	118
<b>Appendix .....</b>		<b>125</b>
A:	Useful Relations .....	125
B:	Table of Integrals and Functions .....	126
<b>Closing Remarks .....</b>		<b>129</b>
<b>References .....</b>		<b>133</b>
<b>Subject Index .....</b>		<b>143</b>

