

Table of Contents

Preface	9
Chapter 1 Introduction to Interfaces and the Forces Involved in their Formation	
1.1 Introduction and definitions	11
1.2 Forces between molecules in bulk matter.	13
1.3 Forces between molecules across interfaces	15
1.4 Attractive forces at interfaces	16
1.5 Measurement of attractive forces at interfaces.	20
1.6 References	20
Chapter 2 Thermodynamic Description of an Interface	
2.1 Introduction.	22
2.2 Definition of an interface	22
2.3 Interfacial tension at a plane surface	23
2.4 The free energy of an interface.	25
2.4.1 The classical approach	25
2.4.2 The methods of Guggenheim and Hill	27
2.4.3 Treatment of an open system by 'classical' methods.	28
2.4.4 The methods of Guggenheim and Hill applied to an open system	29
2.5 The Gibbs-Duhem equation for an interphase	31
2.6 The Gibbs adsorption isotherm	31
2.7 Choice of a dividing surface.	32
2.8 The relationship between the variously defined surface excesses.	35
2.9 Concluding remarks	36
2.10 References	37

Chapter 3 The Study of Liquid Interfaces

3.1	Introduction	38
3.2	Kelvin's equation.	38
3.3	The Laplace equation.	41
3.4	Cylindrical menisci and the measurement of surface tension	42
3.5	Axially symmetric menisci and the measurement of surface tension .46	
3.5.1	Capillary rise	46
3.5.2	The captive bubble and sessile drop methods	51
3.5.3	The pendent drop method.	51
3.5.4	Maximum pull methods	53
3.5.5	Detachment methods.	56
3.5.6	The maximum bubble pressure method	61
3.5.7	Comparison of methods for measuring surface tension	63
3.6	The measurement of interfacial tension	64
3.7	Interfacial energy and interfacial tension of single liquids	65
3.8	Potentials at interfaces	69
3.8.1	Galvani and Volta potentials	69
3.8.2	The experimental measurement of Volta potential differences . .73	
3.8.3	The interpretation of Volta potential difference measurements .77	
3.9	Interfacial viscosity	84
3.9.1	The measurement of interfacial viscosity	87
3.9.2	Capillary waves, and their damping.	90
3.10	Spreading and adhesion in liquid systems.	92
3.11	Adsorption phenomena	96
3.11.1	Soluble films – Gibbs monolayers	96
3.11.2	Non-electrolytes at the liquid-liquid interface	106
3.11.3	The surface of binary liquid mixtures	108
3.11.4	Insoluble surface films	111
3.12	Appendix – Benjamin Franklin's paper to the Royal Society in 1774. Extract	125
3.13	Bibliography.	132
3.14	References.	132

Chapter 4 The Description of Solid Surfaces

4.1	Introduction.	136
4.2	The surface energy of a solid	136
4.2.1	Surface tension and surface free energy	136
4.2.2	Calculated surface energy values.	141
4.3	Imperfections and heterogeneity	145
4.3.1	Lattice defects	146
4.3.2	Non-stoichiometry.	148
4.3.3	Impurity ions	151

4.3.4	Dislocations	152
4.3.5	Crystal growth	154
4.3.6	Surface roughness	156
4.3.7	Heterogeneity	160
4.4	Surface mobility	161
4.5	Surface groups	162
4.6	The adsorption of gases and vapours	163
4.6.1	Physical and chemical adsorption	164
4.6.2	Relation between adsorption potential and the heats of adsorption.	165
4.6.3	Residence times	168
4.6.4	Adsorption potential variations on a real surface	171
4.6.4.1	Adsorption potential maps; solid inert gases	173
4.6.4.2	Adsorption potential maps; ionic solids	177
4.6.4.3	Mobile, localised and pseudo-localised adsorption	182
4.6.5	Monolayer models	185
4.6.6	Determination of surface heterogeneity	192
4.6.7	Multilayer models	197
4.6.8	Surface area determination	208
4.6.9	Porosity.	220
4.7	References	227
 Chapter 5 The Interface between a Liquid and a Solid		
5.1	Introduction.	234
5.2	Wetting	234
5.2.1	Heat of wetting.	242
5.3	Adsorption from solution at the solid-liquid interface.	249
5.3.1	Adsorption from binary liquid mixtures.	250
5.3.2	Adsorption from dilute solutions	257
5.3.2.1	adsorption of non-electrolytes	257
5.3.2.2	adsorption of electrolytes	260
5.3.3	Thermodynamic data from heats of immersion	263
5.4	Practical applications	266
5.4.1	Capillarity	266
5.4.2	Wetting of textiles and powders	266
5.4.3	Detergency.	268
5.4.4	Flotation	269
5.5	References	271
 Index		274