

Contents

	<i>page</i>	xi
<i>Preface</i>		
1 Semiconducting materials	1	
1.1 Materials development and crystal growth techniques	1	
1.2 Electron energy levels and energy bands	10	
1.3 Bonding and the crystal chemistry of semiconducting materials	15	
1.4 Crystal structures of the most important semiconductors	20	
1.5 Symmetry, Bloch waves and energy band theory	27	
1.6 Complex semiconductors and chemical bonding	38	
1.7 Energy band engineering	45	
1.8 Materials development and materials competition	60	
References	67	
2 An introduction to extended defects	73	
2.1 Basic definitions	74	
2.2 Types of extended defect in semiconductors	75	
2.3 Dislocations, plastic deformation and slip systems	77	
2.4 Electrical effects of dislocations in semiconductors	103	
2.5 Plasticity of semiconductors	104	
References	117	
Symbols	120	
3 Characterization of extended defects in semiconductors	122	
3.1 Introduction	122	
3.2 Microscopy techniques	123	
3.3 Light microscopy	123	
3.4 Scanning laser beam microscopy techniques	127	
3.5 Electron microscopy	128	
3.6 Transmission electron microscopy	130	
3.7 Scanning electron microscopy	136	

3.8	Field emission gun scanning transmission electron microscopy	144
3.9	X-ray topography	146
3.10	Scanning probe microscopy	147
3.11	Rutherford backscattering	154
3.12	Positron annihilation spectroscopy	154
	Common acronyms for (micro) characterization techniques	156
	References	157
4	Core structures and mechanical effects of extended defects specific to semiconductors	163
4.1	Atomic core structure of dislocations	163
4.2	Semiconductor dislocation dynamics	222
4.3	Dislocations in II-VI compounds	252
4.4	Plastic deformation and the microdynamical theory of plasticity	278
4.5	Dislocations and area defects: geometry, formation and properties	286
4.6	Epitaxial interfaces and misfit dislocations	331
4.7	Dislocations and point defects	345
4.8	Growth and processing induced defects	357
	References	375
	Symbols	410
5	The electrical, optical and device effects of dislocations and grain boundaries	412
5.1	Introduction to the electrical effects of dislocations and other defects in semiconductors	412
5.2	The electrical effects of the deformation of semiconductors: the Read theory	425
5.3	Recombination at dislocations	436
5.4	The effect of dislocations on optical absorption	446
5.5	SEM EBIC microscopy of individual dislocations	448
5.6	SEM CL microscopy of individual dislocations	485
5.7	Scanning probe microscopy of extended defects	520
5.8	Effect of dislocations on transport properties of epitaxial heterostructures	522
5.9	Summary: the electrical properties of dislocations	530

Cambridge University Press

978-0-521-81934-3 - Extended Defects in Semiconductors: Electronic Properties, Device Effects and Structures

D. B. Holt and B. G. Yacobi

Table of Contents

[More information](#)*Contents*

ix

5.10	The electrical and luminescent effects of grain boundaries in semiconductors	533
5.11	The role of defects in devices	546
5.12	Device benefits of dislocations and grain boundaries	558
	References	572
6	Point defect materials problems	606
6.1	Introduction	606
6.2	Impurity precipitation	606
6.3	Point defect interactions	607
6.4	Phase separation and ordering in semiconducting compounds and alloys	610
6.5	Large-scale, grown-in spatial maldistributions of point defects	611
6.6	Major persisting issues	620
	References	621
	<i>Index</i>	625