

Contents

Abstract IX

Preface XI

List of Contributors XIII

Part 1 Volume Electromagnetic Waves in Anisotropic Crystals with Electronic Plasma 1

Roland H. Tarkhanyan

Introduction 3

1 Influence of the Anisotropy on the Spectrum and Propagation of Electromagnetic, Plasma and Lattice Optical Vibrations 5

1.1 Maxwell's Equations and High-Frequency Conductivity Tensor of an Anisotropic Semiconductor 5

1.2 Complex Dielectric Permittivity Tensor 7

1.3 Dispersion Relations for Electromagnetic Waves. Regions of Propagation. Resonances and Cut-Off Frequencies 9

1.4 Phase and Group Velocities of the Waves 12

1.5 Longitudinal Plasmon Vibrations and Retardation Effect in Nonpolar Semiconductors 13

1.6 Long-Wavelength Optical Vibrations in Uniaxial Polar Crystals 16

2 Bulk Polaritons in Uniaxial Polar Semiconductors 21

2.1 Retardation Effects in Nonconducting Polar Crystals. Dispersion Relations for Phonon–Polaritons 21

2.2 Dispersion of Longitudinal–Transverse Phonon–Polaritons 23

2.3 Dielectric Permittivity Tensor for Uniaxial Polar Semiconductors. Coupling of Plasmons and Optical Phonons 24

- 2.4 Coupling of Electromagnetic and Phonon–Plasmon Vibrations 27
- 2.5 Spectrum of Extraordinary Phonon–Plasmon Polaritons 30

3 Radio Waves and Polaritons in the Presence of an External Static Magnetic Field 33

- 3.1 Dielectric Permittivity Tensor at an Arbitrary Orientation of the Magnetic Field with Respect to the Crystal Axis 33
- 3.2 Propagation of Electromagnetic Waves in Uniaxial Nonpolar Semiconductors Along the Magnetic Field B_0 36
- 3.3 Influence of Crystal Anisotropy on the Faraday Magneto-optical Effect 40
- 3.4 Oscillations of the Rotation Angle and the Ellipticity 42
- 3.5 Propagation in the Direction Perpendicular to B_0 43
- 3.6 Voigt Effect in Uniaxial Semiconductors 47
- 3.7 Influence of the Magnetic Field on Polaritons in Uniaxial Polar Semiconductors 51
 - 3.7.1 Propagation along B_0 52
 - 3.7.2 Propagation in the Case of the Voigt Configuration 56

4 Reflection of Electromagnetic Waves From the Surface of Uniaxial Semiconductors 59

- 4.1 Reflection of s-Polarized Waves From the Surface of a Semi-Infinite Nonpolar Crystal 59
- 4.2 Reflection in the Case of a p-Polarized Incident Wave 61
- 4.3 Influence of Phonon–Plasmon Coupling on Reflection From a Polar Uniaxial Semiconductor 65
- 4.4 Magnetoplasmon Reflection for the Faraday Configuration 66
- 4.5 Magnetoplasmon Reflection for the Voigt Configuration 69

Part 2 Surface and Interface Electromagnetic Waves in Semiconductor Structures 73

Roland H. Tarkhanyan

Introduction 75

5 Surface Polaritons in Uniaxial Semiconductors 77

- 5.1 General Dispersion Relation of Polaritons Bound to the Surface of a Semi-Infinite Semiconductor 77
- 5.2 Amplitude Oscillations of the Surface Waves 79
- 5.3 Peculiarities of Surface Polaritons in Uniaxial Polar Semiconductors in Some Special Cases 80

6	Surface Waves in a Uniaxial Semiconductor Slab	87
6.1	General Theory	87
6.2	Surface Polaritons in a Polar Semiconductor Slab	89
6.3	Quasielectrostatic Surface Waves	91
6.4	Influence of an External Magnetic Field	95
7	Interface Magnon–Plasmon Polaritons and Total Transmission of Electromagnetic Waves Through a Semiconductor/Antiferromagnet Layered Structure	103
7.1	Dispersion Relations and Conditions Necessary for the Existence of Interface Magnon–Polaritons	103
7.2	Properties of TM-type Interface Magnon–Plasmon Polaritons	106
7.3	Effect of Free Carriers on the Properties of TE-type Interface Polaritons	108
7.4	Reflection Coefficient in the Method of Frustrated Total Internal Reflection	110
7.5	Complete Transmission of Electromagnetic Waves by a Two-Layer Structure	113
7.6	Influence of the Anisotropy of a Semiconductor Plasma on the Total Transmission Phenomenon	120
8	Propagation of Electromagnetic Waves on a Lateral Surface of a Ferrite/Semiconductor Superlattice at Quantum Hall Effect Conditions	125
8.1	Model of Effective Permeability and Permittivity Tensors	125
8.2	Partial Waves and Electromagnetic Field Structure	128
8.3	Interface Waves Propagating Along the Lateral Surface	132
8.4	Spectrum of Interface Modes for the Voigt Configuration	134
8.5	Interface Magnon–Plasmon Polaritons in Some Particular Cases	137
Part 3	Electromagnetic Instabilities in Uniaxial Semiconductors with Hot Carriers	139
	<i>Roland H. Tarkhanyan</i>	
	Introduction	141
9	Excitation and Amplification of the Bulk Electromagnetic Waves	143
9.1	Differential Conductivity Tensor	143
9.2	Dispersion Relations for the Waves in the Presence of a Strong Static Electric Field E_0	145
9.3	Instability of the Waves with $k \perp E_0$	148
9.4	Effective Differential Conductivity. Instability in the Absence of a Falling Region in the Current–Voltage Characteristic	151

- 9.5 Instability of the Waves Propagating along E_0 152
- 9.6 Excitation of Extraordinary Waves in a Uniaxial Semiconductor Plate 155
- 9.7 Wave Amplification at Transmission through the Plate 159

- 10 Instabilities of Surface Electromagnetic Waves and Excitation of Guided Charge Density Waves in Semiconductor Heterostructures 161**
- 10.1 Dispersion Relation for Surface Waves in Semiconductors with Hot Bulk Carriers 161
- 10.2 Stability of Surface Waves in the Absence of Retardation 162
- 10.3 Radiative Instability of Surface Electromagnetic Waves 163
- 10.4 Nonradiative Instability of Interface Waves in Semiconductor Heterostructures 165
- 10.5 Constitutive Relations for Current Perturbations in the Presence of a Hot Two-Dimensional Electron Gas (2DEG) 167
- 10.6 Excitation of Quasistatic Interface Waves in Heterostructures with a 2DEG 170
- 10.7 Influence of Hot 2D Carriers on Excitation of Guided Microwave Charge Density Oscillations 172

Part 4 Radiation of a Dipole Source in the Presence of a Grounded Gyromagnetic Dielectric Medium 179
Nikolaos K. Uzunoglu

Introduction 181

- 11 Radiation of a Dipole in the Presence of a Grounded Gyromagnetic Slab 183**
- 11.1 Formulation of the Problem 183
- 11.2 Dyadic Green's Function for Perpendicular Magnetization 186
- 11.3 Derivation of Green's Function for Parallel Magnetization 191
- 11.4 Far-Field Behavior 194
- 11.5 Numerical Results 199

References 205

Index 209