

Nano- and Micromaterials

Bearbeitet von
Kaoru Ohno, Masatoshi Tanaka, Jun Takeda, Yoshiyuki Kawazoe

1. Auflage 2008. Buch. xv, 337 S. Hardcover

ISBN 978 3 540 74556 3

Format (B x L): 15,5 x 23,5 cm

Gewicht: 767 g

[Weitere Fachgebiete > Physik, Astronomie > Thermodynamik > Festkörperphysik,
Kondensierte Materie](#)

schnell und portofrei erhältlich bei

The logo for beck-shop.de features the text 'beck-shop.de' in a bold, red, sans-serif font. Above the 'i' in 'shop' are three red dots of increasing size. Below the main text, 'DIE FACHBUCHHANDLUNG' is written in a smaller, red, all-caps, sans-serif font.

beck-shop.de
DIE FACHBUCHHANDLUNG

Die Online-Fachbuchhandlung beck-shop.de ist spezialisiert auf Fachbücher, insbesondere Recht, Steuern und Wirtschaft. Im Sortiment finden Sie alle Medien (Bücher, Zeitschriften, CDs, eBooks, etc.) aller Verlage. Ergänzt wird das Programm durch Services wie Neuerscheinungsdienst oder Zusammenstellungen von Büchern zu Sonderpreisen. Der Shop führt mehr als 8 Millionen Produkte.

Contents

1 General Introduction	
<i>K. Ohno</i>	1
References	15
2 Nanometer-Scale Structure Formation on Solid Surfaces	
<i>M. Tanaka, K. Shudo, and S. Ohno</i>	19
2.1 Introduction	19
2.2 Atomic Layer Etching Processes on Silicon Surfaces	21
2.2.1 Introduction	21
2.2.2 Real-Time Optical Measurements	24
2.2.3 Adsorption of Halogen Atoms: Sticking Coefficient and Potential Barrier	26
2.2.4 Site-Selective Adsorption	34
2.2.5 Desorption of Silicon Halides and Restoration of the DAS Structure	39
2.2.6 Summary	48
2.3 Nanoscale Fabrication Processes of Silicon Surfaces with Halogens .	50
2.3.1 Introduction	50
2.3.2 Scanning Tunneling Microscopy	53
2.3.3 Thermal Desorption Process	56
2.3.4 Cluster Alignment by Passive Fabrication	62
2.3.5 Active Fabrication	68
2.3.6 Summary	76
2.4 Self-Organized Nanopattern Formation on Copper Surfaces	77
2.4.1 Introduction	77
2.4.2 Experiments	78
2.4.3 Novel Phenomena on Cu(001)-c(2×2)N.....	79
2.4.4 Nanopattern Formation at Vicinal Surfaces	79
2.4.5 Strain-Dependent Nucleation of Metal Islands	82
2.4.6 Strain-Dependent Dissociation of Oxygen Molecules	85
2.4.7 Summary	88
References	89

3 Ultrafast Laser Spectroscopy Applicable to Nano- and Micromaterials

<i>J. Takeda</i>	97
3.1 Introduction	97
3.2 Femtosecond Optical Kerr Gate Luminescence Spectroscopy	97
3.2.1 Time-Resolved Luminescence Spectroscopy: Up-Conversion Technique vs. Optical Kerr Gate Method ...	97
3.2.2 Femtosecond OKG Method: Experimental Setup and Results	99
3.3 Femtosecond Transient Grating Spectroscopy Combined with a Phase Mask	105
3.3.1 Principle of Transient Grating Spectroscopy	105
3.3.2 Transient Grating Spectroscopy Combined with a Phase Mask: Experimental Setup and Results	107
3.4 Femtosecond Real-Time Pump-Probe Imaging Spectroscopy	109
3.4.1 Principle of Real-Time Pump-Probe Imaging Spectroscopy .	109
3.4.2 Experimental Demonstrations of Real-Time Pump-Probe Imaging Spectroscopy	112
References	117

4 Defects in Anatase Titanium Dioxide

<i>T. Sekiya and S. Kurita</i>	121
4.1 Introduction	121
4.2 Growth of Anatase Single Crystal	122
4.3 Control of Defect States	123
4.3.1 Heat Treatment Under Oxygen Pressure	123
4.3.2 Heat Treatment Under Hydrogen Atmosphere	124
4.4 Properties of Anatase	129
4.4.1 Absorption Edge	129
4.4.2 Photoluminescence	131
4.4.3 EPR Spectra	132
4.4.4 Electric Conduction	134
4.5 Carrier Control by Photoirradiation	137
4.5.1 Photoconductivity	137
4.5.2 EPR	138
References	140

5 Organic Radical 1,3,5-Trithia-2,4,6-Triazapentalenyl (TTTA) as Strongly Correlated Electronic Systems: Experiment and Theory

<i>J. Takeda, Y. Noguchi, S. Ishii, and K. Ohno</i>	143
5.1 Introduction	143
5.2 Crystalline Structure	144

5.3	Experimental	146
5.3.1	Paramagnetic Susceptibility and Electron Spin Resonance	146
5.3.2	Reflectivity	150
5.3.3	Photoinduced Magnetic Phase Transition	151
5.4	Electronic Structure Calculations	157
5.4.1	Results Within the LDA	157
5.4.2	Breakdown of the LDA	161
5.4.3	T -Matrix Theory	162
5.4.4	Results in the T -Matrix Theory	164
5.4.5	Concluding Remarks	167
	References	168
 6 Ab Initio GW Calculations Using an All-Electron Approach		
	<i>S. Ishii, K. Ohno, and Y. Kawazoe</i>	171
6.1	Introduction	171
6.2	Many-Body Perturbation Theory and GW Approximation	172
6.3	Choice of Basis-Set Function	175
6.4	Application to Clusters and Molecules	176
6.4.1	Alkali-Metal Clusters	176
6.4.2	Semiconductor Clusters	178
6.4.3	Gallium Arsenide Clusters and Crystal	180
6.4.4	Benzene Molecule	183
6.4.5	Why Are LDA Eigenvalues of HOMO Level Shallower Than Experiments?	184
6.5	Self-Consistent GW vs. First Iterative GW (G_0W_0)	184
6.6	Appendix: Proof of WT Identity	185
6.7	Summary	187
	References	187
 7 First-Principles Calculations Involving Two-Particle Excited States of Atoms and Molecules Using T-Matrix Theory		
	<i>Y. Noguchi, S. Ishii, and K. Ohno</i>	189
7.1	Background	189
7.2	Methodology: T -Matrix Theory	191
7.3	Double Electron Affinity of Alkali-Metal Clusters	193
7.3.1	Introduction	193
7.3.2	Effect of the Coulomb Interaction in the DEA Spectra	193
7.3.3	Short-Range Repulsive Coulomb Interaction Within the T -Matrix Theory	195
7.3.4	Summary	196
7.4	Double Ionization Energy Spectra	196
7.4.1	Introduction	196
7.4.2	Two-Valence-Electron Systems	198

7.4.3	Inert Gas Atoms	199
7.4.4	CO and C ₂ H ₂ Molecules	200
7.4.5	Summary	202
7.5	Two-Electron Distribution Functions and Short-Range Electron Correlations	202
7.5.1	Introduction	202
7.5.2	Methodology	204
7.5.3	Ar	204
7.5.4	CO	206
7.5.5	CO ₂	208
7.5.6	C ₂ H ₂	210
7.5.7	Summary	211
7.6	Summary	212
7.7	Appendix	213
7.7.1	Fourier Transformation of Green's Function	213
7.7.2	Fourier Transformation of <i>K</i> -Matrix	214
7.7.3	Fourier Transformation of <i>T</i> -Matrix	215
	References	216

8 Green's Function Formulation of Electronic Transport at Nanoscale

	<i>A.A. Farajian, O.V. Pupyshova, B.I. Yakobson, and Y. Kawazoe</i>	219
8.1	Introduction	219
8.2	Landauer's Transport Formalism: The Green's Function Implementation	220
8.2.1	Multichannel Landauer's Formula	220
8.2.2	Surface Green's Function Matching Method	221
8.2.3	Scattering Matrix and Transport Properties	223
8.2.4	Alternative Formulation of the Total Conductance	226
8.3	Carbon Nanotube Heterostructures	227
8.3.1	Conductance of Nanotubes with Vacancy or Pentagon-Heptagon Defects	227
8.3.2	Doped Nanotube Junctions: Rectification and Novel Mechanism for Negative Differential Resistance	230
8.3.3	Effects of Random Disorder on Transport of Nanotubes	234
8.4	Functional Molecule Between Two Metallic Contacts	235
8.4.1	Transport Through Xylyl-Dithiol Molecule Attached to Two Gold Electrodes	235
8.4.2	Transport Through Benzene-Dithiol Molecule Attached to Two Gold Electrodes	238
8.5	Summary	239
	References	240

9 Self-Assembled Quantum Dot Structure Composed of III–V Compound Semiconductors

<i>K. Mukai</i>	243
9.1 Introduction	243
9.2 Control of QD Structure by Growth Condition	244
9.2.1 Control of Growth Parameters	244
9.2.2 Closely Stacked QDs	246
9.2.3 QD Buried in Strained Layer	248
9.3 Growth Process of QD Structure	252
9.4 Analysis of QD Structure	256
9.4.1 Grazing Incidence X-Ray Scattering	256
9.4.2 Scanning Tunneling Microscopy	258
9.5 Summary and Perspective	259
References	260

10 Potential-Tailored Quantum Wells for High- Performance Optical Modulators/Switches

<i>T. Arakawa and K. Tada</i>	263
10.1 Introduction	263
10.2 Parabolic Potential Quantum Well	264
10.3 Graded-Gap Quantum Well	266
10.4 Asymmetric Coupled Quantum Well	268
10.5 Intermixing Quantum Well	271
10.6 Summary	272
References	272

11 Thermodynamic Properties of Materials Using Lattice-Gas Models with Renormalized Potentials

<i>R. Sahara, H. Mizuseki, K. Ohno, and Y. Kawazoe</i>	275
11.1 Introduction	275
11.2 Scheme of the Potential Renormalization	276
11.3 Application of the Potential Renormalization	278
11.3.1 Application to Melting Behavior of Si	278
11.3.2 Application to Cu–Au Phase Diagram	282
11.3.3 Application to Transition and Noble Metals	286
11.3.4 Order–Disorder Phase Transition of $L1_0$ FePt Alloy Using the Renormalized Potential Combined with First-Principles Calculations	287
11.4 Summary	289
References	289

12 Optically Driven Micromachines for Biochip Application

<i>S. Maruo</i>	291
12.1 Introduction	291
12.1.1 Two-Photon Microstereolithography for Production of 3D Micromachines	292

XII Contents

12.1.2 Assembly-Free, Single-Step Fabrication Process of Movable Microparts	293
12.2 Optically Driven Micromachines	296
12.2.1 Optical Trapping	296
12.2.2 Optical Driving Method of Multiple Micromachines	298
12.2.3 Optimization of Time-Divided Laser Scanning	300
12.2.4 Cooperative Control of Micromanipulators	302
12.2.5 Optically Driven Micropump	303
12.2.6 Concept of All-Optically Controlled Biochip	307
12.3 Conclusion and Future Prospect	307
References	308
13 Study of Complex Plasmas	
<i>M. Shindo and O. Ishihara</i>	311
13.1 Overview of Complex Plasma Research	311
13.2 Charging of a Dust Particle in a Plasma	312
13.3 Measurements of the Charge of Dust Particles Levitating in Electron Beam Plasma [12]	313
13.4 Various Approaches to Plasma-Aided Design of Microparticles System in Ion Flow	315
13.4.1 Analysis of Ion Trajectories Around a Dust Particle in Ion Flow [17]	316
13.4.2 Wake Potential Formation to Bind Dust Particles Aligned Along Ion Flow	318
13.4.3 Attractive Force Between Dust Particles Aligned Perpendicular to Ion Flow [30]	320
13.5 Simulation Study of Cluster Design of Charged Dust Particles	321
13.6 Complex Plasma Experiment in Cryogenic Environment [38]	323
13.7 Summary	325
References	326
Index	329