

## CONTENTS

### Section III. SPUTTERING AND SURFACE SCATTERING

#### 1. General Problems of Sputtering

- M. W. Thompson, I. H. Reid and B. W. Farmery. Atomic Collision Processes in Sputtering . . . . . 8
- V. E. Yurasova. Atomic Particle Emission Under Ion Bombardment of Single Crystals . . . . . 13
- W. L. Brown, Z. L. Liao, J. W. Mayer, J. M. Poate. Alloy Sputtering . . . . . 18
- M. V. Kuvakin, E. S. Kharlamochkin. Focuson Statistics in Sputtering . . . . . 20
- V. E. Dubinskii. Prediction of Extremum and Bends in Angular Distributions of Secondary Particles During Bombardment of Polycrystals by Directed Beams . . . . . 24
- R. A. Baragiola. A Mechanism for Damage and Sputtering of Non-Metals by Low Energy Ions . . . . . 27
- K. H. Ecker, J. P. Biersack. Transmission Sputtering Experiments and Monte Carlo Simulations . . . . . 29
- W. Hauffe. Evidence of a Faceting Mechanism in the Sputtering Process . . . . . 33
- T. A. Tombrello. Sputtering in Astrophysics and Planetary Science . . . . . 35
- G. Maderlechner, R. Behrisch, B. M. U. Scherzer, M. T. Robinson. Sputtering Yield Calculations for Light-Ions Near Threshold Energies . . . . . 39
- K. I. Gusev, S. Yu. Mikheyev, Yu. A. Ryzhov, D. S. Strizhenov, I. I. Shkarban. Sputtering of Titanium and Its Alloys by 1 to 6 keV He<sup>+</sup> Ions . . . . . 39
- B. Navinšek, M. Peternel, A. Zabkar. High Ion Erosion Rates Produced on Various Stainless Steels and Nickel-Base Alloys by 12 keV He<sup>+</sup> Ion Bombardment . . . . . 41
- G. Betz, W. Färber, P. Braun. Sputtering Yields for Two-Phase Ag—Cu Thin Film Alloys . . . . . 50
- W. Husinsky, R. Bruckmüller, P. Blum. Velocity Measurements of Neutral Sputtered Particles by Means of a Doppler Shift Laser Spectrometer . . . . . 52
- H. Oechsner, J. Bartella. Comparative Studies of the Energy Distribution of Neutral Atoms Sputtered from a NiW-Alloy and from Elemental Ni and W by 2.5 keV Ar<sup>+</sup>—Ions . . . . . 55
- S. Ya. Lebedev, G. V. Lysova. Investigation of the Angular Distributions of the Sputtered Atoms of Gold Single Crystals . . . . . 57
- R. J. MacDonald, B. Parish, D. J. O'Connor. Variation of Spot Intensity in Single Crystal Ejection Patterns as a Function of the Ion Incidence . . . . . 59
- P. Erlenwein, H. Niedrig. Temperature Dependence of Sputtered Spot Patterns Investigated by Electron Backscattering . . . . . 65

#### 2. Surface Morphology

- G. Carter, M. J. Nobes, J. L. Whitton, L. Tanovic, J. S. Williams. Experimental and Theoretical Studies of Bombardment Induced Surface Morphology Changes . . . . . 69
- Sh. G. Askerov, D. M. Nasrullayev. Influence of Surface Microstructure on Cathode Sputtering of Metals in the Near-Threshold Energy Region . . . . . 82
- L. A. Tanovič, J. L. Whitton, G. Carter, M. J. Nobes, J. S. Williams. The Development of Pits and Cones on Ion Bombarded Copper . . . . . 88

- V. N. Opekunov, A. A. Predvoditelev. Investigation of the Initial Stages of Surface Erosion of Solids Under Ion Bombardment by the Vacuum Decoration Method . . . . . 87
- N. Bibič, T. Nenadovič, B. Perovič. Surface Topography of Ion Bombarded CuAg Alloys . . . . . 90
- V. G. Telkovsky, L. B. Begrambekov, A. N. Cubyshkin. Dielectric Surface Structure Change Under Ion Irradiation . . . . . 91

#### 3. Surface Scattering

- E. S. Parilis. Charge State of Ions Scattered by the Solid Surface . . . . . 96
- F. E. P. Matschke, W. Eckstein, H. Verbeek. Charge State of Hydrogen Backscattered from a Gold Single Crystal . . . . . 98
- J. E. Robinson, S. A. Agamy. Energy Spectra and Charge States for H and He Backscattered from Si in the Energy Range of 1.5—10 keV . . . . . 101
- S. B. Luitjens, A. L. Boers. Energy Spectra of Neutral Particles Measured with the Time-of-Flight and the Stripping Technique . . . . . 103
- W. Eckstein, V. A. Molchanov, H. Verbeek. The Charge State of He Backscattered from Ni . . . . . 104
- E. B. Ainetdinov, G. I. Zhabrov, V. A. KurnaeV, V. G. Telkovsky. Energy and Charge Distributions in Scattered Flux under 5—60 keV Hydrogen Ion Bombardment of Copper Target . . . . . 106
- L. L. Balashova, E. S. Mashkova, V. A. Molchanov. Energy Dependences in Surface Scattering . . . . . 109
- L. C. Feldman, R. L. Kauffman, P. J. Silverman, I. Stensgaard, R. A. Zuhr. Surface Scattering of MeV He<sup>+</sup> Ions from W (100) and Si (100) Single Crystals . . . . . 112
- C. Varelas, K. Günther, R. Sizmann. Influence of Surface Contamination on Energy Distribution of Surface Channeled Ions . . . . . 116
- L. B. Shelyakin, G. Schaarschmidt, V. E. Yurasova. Scattering and Sputtering under Bombardment of a Single Crystal by a Gliding Ion Beam . . . . . 119
- O. S. Oen. Some Analytical Solutions to the Two Atom Blocking Model . . . . . 124
- V. I. Shulga. The Angular Distribution of Ion Scattered by Single-Crystal Surface Semichannels . . . . . 128
- M. Hou, M. T. Robinson. Computer Simulation of the Grazing Incidence Backscattering of Protons from a (110) Nickel Surface . . . . . 132
- S. Yu. Lukjanov, V. M. Chicherov. Interaction of Medium Energy Ions with Thin-Layer Targets . . . . . 136
- D. P. Jackson. The Influence of Stopping Power on the Reflection Coefficients of Hydrogen Ions from Stainless Steel . . . . . 141

### Section IV. EMISSION OF SECONDARIES AND RADIATION IN ION BOMBARDMENT

#### 1. Ion Emission

- R. J. MacDonald. Photon Emission from Ion Bombarded Solids . . . . . 143
- V. T. Cherepin, M. A. Vasiliev. Secondary Ion Emission from Concentrated Alloys and Compounds . . . . . 149

A. G. Koval', V. N. Mel'nikov, V. V. Bobkov, Yu. A. Klimovskii. Studies of Physical-chemical Processes under Surface of Metals and Semi-conductors by the Method of Mass Spectroscopy of Secondary Ions	151
J. Antal. On the Quantum Theory of the Emission of Secondary Ions from Metal Surfaces	155
E. O. Rausch, E. W. Thomas. Formation of Excited H by Impact of $H_1^+$ , $H_2^+$ , $H_3^+$ Ions on Metal Surfaces	157
A. H. Ayukhanov, M. K. Abdullaeva, E. Turmashev. Negative-Ion Formation Efficiency in Sputtering Surfaces Activated by an Alkali Metal	158
V. M. Bukhanov, Kh. A. Motavekh. Orientation Dependence of Secondary Ion Emission in the Direction of Close Packing	161
V. G. Litovchenko, G. Ph. Romanova, R. I. Marchenko, P. I. Dedenko. An Investigation of Peculiarities of Dielectric Film Ion Sputtering by Means of the SIMS Technique	162
A. A. Adylov, V. I. Veksler, B. A. Tsipinyuk. Some Aspects of the Secondary Ion Emission from Metals	166
Z. Jurela. Periodical Dependence of Physical Parameters Defining the Yield of Sputtered Ions	170
G. D. Tansyrev. Concerning Some General Regularities of Secondary Ion Emission from Organic Substances	172

## 2. Electron Emission

A. A. Dorozhkin, A. A. Petrov, N. N. Petrov. Auger Electrons in the Energy Spectra of Ion-Electron Emission	175
S. Ya. Lebedev, D. D. Odintsov, Yu. V. Chmyrev. Investigation of the Energy Distributions of Electrons Knocked-out with Fission Fragments from Gold Polycrystal and Single-Crystal Films	177
G. Holmén, B. Svensson, A. Burén. Secondary Electron Emission from Polycrystalline Copper Bombarded by Ions	181
N. Benazeth, C. Benazeth, L. Viel. Determination by Auger Spectroscopy of $Al_{23}$ Shell Ionization Cross Sections Induced by Light and Heavy-Ion Impacts	182
A. Koyama. Theory of the Secondary Electron Emission from Al by High Energy Proton or $\alpha$ -Particle Bombardment	185
A. Ortykov, R. Rakhimov. Electron Emission from Metal-Film Systems under the Atomic Particle Bombardment	188

## V. ION IMPLANTATION AND RADIATION DEFECTS

### 1. Ion Implantation

P. V. Pavlov, O. N. Gorshkov, V. K. Vasil'ev, D. I. Tetelbaum, E. I. Zorin. Some Problems of Atomic Collision Physics in Application to Ion Implantation	192
L. T. Chadderton, E. Johnson, S. A. Komolov. The Annealing Behaviour of Dysprosium Ion Implanted Nickel Studied by Total Current Spectroscopy	195
K. Gärtner, K. Hehl. Cross Section of Elastic Scattering of Ions on Atoms	197
V. A. Muralev. Range Distribution and Space Distributions of Radiation-Induced Defects in Materials Irradiated with Monoenergetic Ions	198
M. A. Betuganov, S. S. Gorelik, M. Yu. Digilov, V. I. Kostikov, Kh. B. Khokonov. Some Problems of Recoil-Atom Implantation Theory	201
G. Fischer, J. S. Colligon, A. E. Hill. On Experimental and Theoretical Considerations of Recoil Implantation	205
V. S. Remizovich, A. I. Rudenko. On the Kinetics of Charged Particle Implantation in Dielectrics Taking into Account the Effect of Space Charge Build-Up	208
A. Grob, J. J. Grob, P. Siffert. Spatial Distributions of Energy Deposited by Heavy Ions into Nuclear Collisions	210
B. M. Latta, J. D. MacArthur, P. J. Scanlon. Multiple Scattering of 57 keV $^{29}P$ in Si	215

V. F. Grishchenko, G. A. Shevelev, Yu. V. Gorrelkinskii, V. A. Botkin. Distribution of Paramagnetic Centers and Implanted Atoms Produced in Silicon by $^{235}U$ Fission Fragments	219
A. N. Grigor'ev, N. P. Dikiy, P. P. Matyash, L. I. Nikolajchuk, P. A. Svetashev, N. A. Skakun. Lattice Location in Lithium Atoms Implanted into Cadmium Sulphide	220
A. G. Wagh, J. Williams, E. Uggerhoj. The Effect of Planar Oscillations on the Impurity Yield in the Backscattered $He^+$ Spectrum	222
G. Götz, G. Sommer. Self-Interstitial Location in Boron-Implanted Silicon Crystals Measured by Backscattering Method	227
J. B. Roberto, M. T. Robinson. A Measurement of the Transverse Range of (n, 2n) Recoils in Au	232
L. Pranevičius, Yu. Navickas, V. Riauka, S. Skilinskas. A Study of Radiation Damages in Semiconductors by the Method of Galvano-Magnetorecombination Effect	234
O. A. Novozhilov, I. B. Khaibullin, S. R. Novikov, L. I. Meshcherskaya. The Anomalous Behaviour of the Optical Properties of Ion-Implanted Germanium	236
A. P. Koshcheev, A. M. Panesh. The Influence of Low Energy Ion Trapping on Electric Properties Semiconductor Oxide Films	239

## 2. Radiation Defects

M. L. Swanson, L. M. Howe, N. Matsunami. The Study of Point Defects by Channeling Measurements of Solute Atom Displacements	241
I. A. Abroyan, V. S. Belyakov, A. I. Titov, A. V. Khlebalkin. Radiation-Induced Defects in Silicon and Germanium and a Secondary Emission Method	247
S. U. Campisano, G. Foti, E. Rimini, S. T. Picraux. Dechanneling by Extended Defects	251
E. Glaser, G. Götz, K. Hehl. Evidence of Various Defect Types from Dechanneling Measurements	258
U. Finger, K. Gärtner, K. Hehl. Theoretical Description of Dechanneling in Imperfect Crystals	262
E. F. Krimmel, H. Oppolzer, H. Runge. Electron Microscopical Observation of Radiation Damage Distributions in Ion Implanted $SiO_2-Si$ Structures	265
N. V. Doan. Computer Simulation of Some Elementary Processes in Radiation Damage in Solids	268
P. V. Pavlov, N. P. Morozov, D. I. Tetelbaum, E. I. Zorin. The Effect of Stationary Force Fields on the Concentration and Distribution of Radiation Damage in Atomic Collision Cascades	271
Sh. Sh. Ibragimov, A. I. Kozin, G. P. Chursin. The Role of Inelastic Processes in the Displaced Atom Production Under Irradiation of Materials by Neutrons and Charged Particles	274
R. Grötzschel, R. Klages, U. Kreißig, J. Rüdiger, M. Voeliskow, J. Krynicki, J. Suski. Laser Annealing of Disordered Regions in Silicon	276
J. Odeurs, H. Pattyn, S. R. Reintsema, R. Dekeersmaecker. Experimental Investigation of the Gross Structure of Damage Cascades by means of Ion Implantation at Different Energies	280
S. R. Reintsema, J. Odeurs, E. Verbiest, H. Pattyn, R. Coussemont. The Vacancy Annealing Stage in Heavy Ion Implanted BCC Metals	282
A. V. Dvurechensky, L. S. Smirnov. The Inducement and Rearrangement of Radiation Defects in Ion Implanted Semiconductors	284
I. M. Belyi, F. F. Komarov, I. S. Tashlykov, G. Götz, G. Schirmer. Radiation Damage and Implanted Impurity Distribution in GaAs at P-ion Implantation	287

## 3. Thermonuclear Applications

V. M. Gusev, M. I. Guseva, U. L. Krasulin, U. V. Martinenko, S. K. Das, M. S. Kaminsky. Radiation Blistering of Nb Implanted with Helium Ions of Energies Expected in the Fusion Reactor	291
--	-----

M. Kaminsky. Surface Effects in Fusion Device Operation	294	Stoichiometric Changes by Bombardment of Ta <sub>2</sub> O <sub>5</sub> with keV Light Ions	327
R. Behrisch, B. M. U. Scherzer. Which Atomic Processes Dominate Plasma Wall Interaction?	306	S. E. Donnelly, R. Webb, D. G. Armour, G. Carter. Ion Bombardment Induced Evolution of Inert Gases Trapped in Solids	330
V. G. Tel'kovsky, A. A. Pisarev, S. I. Ukolov. Capture of H <sup>+</sup> and D <sub>2</sub> <sup>+</sup> Ions by Stainless Steel	316	N. P. Katrich, G. T. Adonkin. Effect of Surface State, Structure and Crystallographic Orientation of Single Crystals on the Implantation of Fast Hydrogen Ions	337
G. G. Bondarenko, V. V. Vasilevsky, L. I. Ivanov, N. A. Makhlin, A. A. Shmykov. The Influence of Post Irradiation Annealing on the Evolution of Stainless Steel Surface Structure Bombarded with Helium Ions	318	J. Takahashi, K. Ozawa, S. Yamaguchi, Y. Fujino, O. Yoshinari, M. Hirabayashi. Channeling Study on the Thermal Motion of Deuterium in Palladium Alloy	340
G. G. Bondarenko, V. V. Vasilevsky, L. I. Ivanov, L. M. Ivanova, A. A. Kostev, N. A. Makhlin. The Surface Erosion of Silicon Carbide Irradiated with Helium Ions	321	V. E. Dubinskii, S. Ya. Lebedev, S. I. Rudnev. Blistering on Nickel and Steels Irradiated with Argon and Nitrogen Ions	343
N. P. Katrich, A. T. Budnikov. Some Features of Blistering Formation during Metal Bombardment by Hydrogen Ions	323	V. I. Krotov, S. Ya. Lebedev. Nickel Blistering by Helium Ions Irradiation	345
H. von Seefeld, R. Behrisch, B. M. U. Scherzer, Ph. Staib, H. Schmidl. Sputtering and		R. M. Ibragimov, Sh. Sh. Ibragimov, V. V. Kirsanov. Computer Simulation of the Extended Target Radiation Damage of Medium Energy Protons	348