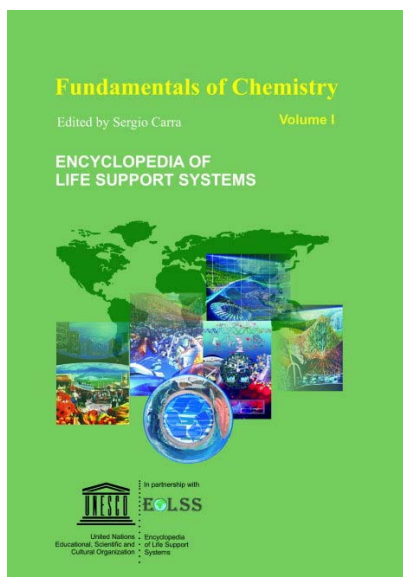


CONTENTS

FUNDAMENTALS OF CHEMISTRY



Fundamentals Of Chemistry - Volume 1

No. of Pages: 469

ISBN: 978-1-905839-58-2 (eBook)

ISBN: 978-1-84826-958-3 (Print Volume)

Fundamentals Of Chemistry - Volume 2

No. of Pages: 515

ISBN: 978-1-905839-59-9 (eBook)

ISBN: 978-1-84826-959-0 (Print Volume)

For more information on e-book(s) and Print Volume(s) order, please [click here](#)

[Or contact : eolssunesco@gmail.com](mailto:eolssunesco@gmail.com)

CONTENTS

VOLUME I

The World of Chemistry	1
Sergio Carra, <i>Dipartimento di Chimica, Materiali e Ingegneria Chimica “G. Natta” del Politecnico, Milan, Italy</i>	
Maurizio Masi, <i>Dipartimento di Chimica, Materiali e Ingegneria Chimica “G. Natta” del Politecnico, Milan, Italy</i>	

1. Centrality of Chemistry in Human Activities, Life, and Culture
2. The Impact of Chemistry on Technological Development
3. Peculiarities of Chemical Processes
4. Relevance of the Molecular Approach
5. Molecular Dynamics
6. Engineering of Industrial Processes
7. Polymeric Materials
8. Advanced Materials, Nanostructures, and Mechanical Electronics

A History of Chemistry	27
Fabrizio Trifirò, <i>University of Bologna, Italy</i>	
Ferrucci Trifiro, <i>University of Bologna, Italy</i>	

1. Introduction
2. The Birth of Chemistry as a Science
 - 2.1. From Alchemy to Chemistry
 - 2.2. The Skeptical Chemist
 - 2.3. Pneumatic Chemistry
 - 2.4. The Chemical Revolution
3. Definition of the Building Blocks of Chemistry
 - 3.1. Atoms
 - 3.2. Molecules
4. The Elements
 - 4.1. Discovery of the Elements
 - 4.2. The Periodic Law of the Elements
5. Thermodynamics
 - 5.1. The Laws of Thermodynamics
 - 5.2. The Development of Thermochemistry
 - 5.3. Chemical Affinity
6. Chemical Dynamics
 - 6.1. Reaction Kinetics
 - 6.2. Catalysis
7. The States of Matter
 - 7.1. The Gaseous State
 - 7.2. The Liquid State
 - 7.3. The Solid State
8. Valence Theory
9. Spectroscopic Analysis
 - 9.1. Spectral Analysis
 - 9.2. Color Analysis
 - 9.3. X-ray Diffraction Analysis
10. Stereochemistry
11. Electrochemistry
12. Organic Chemistry
 - 12.1. From Vital Forces to Synthesis
 - 12.2. Importance of Accurate Quantitative Analysis

- 12.3. Problem of the Representation of Organic Molecules
- 12.4. New Synthetic Routes
- 13. Discoveries of New Products and Less Expensive Processes
 - 13.1. Synthetic Dyes
 - 13.2. Explosives
 - 13.3. Plastics and Fibers
 - 13.4. The Alkali Industry
 - 13.5. Nitrogen Fixation
 - 13.6. Oxidation of SO₂
 - 13.7. Evolution of the Cracking of Petroleum
 - 13.8. Tetraethyl Lead

Chemical Matter: Elements and their Classification through the Periodic System

71

Renato Ugo, *Università di Milano, Italy*

- 1. Introduction
- 2. Introduction to the Electronic Structure of Atoms
- 3. The Building Up of the Periodic Table
- 4. The Periodical Trends of Some Physical Properties
 - 4.1. Ionization Energies
 - 4.2. Size of Atoms
 - 4.3. Electron Affinities
- 5. Some Periodical Trends of the Chemical Behavior
 - 5.1. From Metals to Nonmetals
 - 5.2. The Binding Energies
 - 5.3. Electronegativity
 - 5.4. The Electrochemical Properties of the Metallic Elements

The Contribution of Nobel Laureates to Chemistry

98

Ferrucci Trifiro, *Dipartimento di Chimica Industriale e dei Materiali, University of Bologna, Italy*

- 1. Introduction
- 2. The Discovery of New Elements
 - 2.1. The Filling and Expansion of the Periodic Table
 - 2.2. The Isotopes
- 3. The Properties of Atoms
 - 3.1. The Birth of Nuclear Chemistry
 - 3.2. The Development of Quantum Mechanics
- 4. The Properties of Molecules
 - 4.1. The Discovery of Coordination and Metallorganic Compounds
 - 4.2. The Discovery of New Organic Molecules
 - 4.3. The Emergence of Quantum Chemistry
- 5. The Expansion of Thermodynamics
 - 5.1. Equilibrium Thermodynamics
 - 5.2. Nonequilibrium Thermodynamics
- 6. The Dynamics of Chemical Reactions
 - 6.1. Kinetics of Heterogeneous and Homogeneous Processes
 - 6.2. The Identification of the Activated State
- 7. New Synthetic Routes for Useful Products
 - 7.1. Via Catalysis
 - 7.2. Via Synthesis in Extreme Experimental Conditions
 - 7.3. Natural Products via Multistep Synthesis
 - 7.4. Via New Synthetic Strategies
 - 7.5. Via New Reactants or Reagents
- 8. The Understanding of Natural Processes
 - 8.1. From Ferments to Enzymes

- 8.2. Understanding the Mechanism of Action of Enzymes
- 8.3. Mechanisms of Important Natural Processes
- 8.4. Characterization of Biologically Important Molecules
- 8.5. The Development of DNA-Based Chemistry
- 9. The Identification of Chemical Entities
 - 9.1. Analytical Methods
 - 9.2. New Separation Techniques
 - 9.3. The Development of New Instrumentation for Structure Analysis

Chemical Laboratory Techniques

122

Davino Gelosa, *Politecnico di Milano, Italy*
 Andrea Sliepceovich, *Politecnico di Milano, Italy*

- 1. Common Laboratory Apparatus
 - 1.1. Glassware
 - 1.2. Heating of the Reaction Mixture
 - 1.2.1. Burners
 - 1.2.2. Heating Baths
 - 1.2.3. Electric Hot Plates and Electric Heating Mantles
 - 1.3. Cooling of the Reaction Mixtures
 - 1.4. Stirring
- 2. The Reaction
 - 2.1. Batch Reactors
 - 2.2. Continuous Stirred-Tank Reactors
 - 2.3. Tubular Reactors
 - 2.3.1. Pulse Reactors
- 3. Isolation and Purification Techniques
 - 3.1. Filtration
 - 3.2. Extraction
 - 3.2.1. Liquid–Liquid Extraction
 - 3.2.2. Liquid–Solid Extraction
 - 3.3. Crystallization
 - 3.4. Distillation
 - 3.4.1. Theoretical Aspects
 - 3.4.2. Simple Distillation
 - 3.4.3. Fractional Distillation
 - 3.4.4. Distillation under Reduced Pressure
 - 3.4.5. Steam Distillation

Gas and Liquid Chromatography

164

Andrea Sliepceovich, *Politecnico di Milano, Italy*
 Davino Gelosa, *Politecnico di Milano, Italy*

- 1. Introduction
- 2. Evolution and Classification of Chromatography
 - 2.1. Adsorption Chromatography
 - 2.2. Partition Chromatography
 - 2.3. Ion-Exchange and Size-Exclusion Chromatography
 - 2.4. Affinity Chromatography
- 3. Chromatographic Theory
 - 3.1. Distribution of Analytes Between Phases
 - 3.2. Separation Efficiency
- 4. Gas Chromatography
 - 4.1. Sample Introduction
 - 4.1.1. Packed-Column Injector
 - 4.1.2. Inlet for Capillary Column

- 4.2. Column
- 4.3. Detectors
 - 4.3.1. Hot-Wire Detector
 - 4.3.2. Flame-Ionization Detector
 - 4.3.3. Electron-Capture Detector
 - 4.3.4. Mass-Spectrometer Detector
5. High Performance Liquid Chromatography
 - 5.1. Instrumentation for HPLC
 - 5.1.1. Mobile-Phase Reservoir
 - 5.1.2. Pumps
 - 5.1.3. Injectors
 - 5.1.4. Columns
 - 5.1.5. Detectors
6. Analytical Objectives
 - 6.1. Qualitative Analysis
 - 6.2. Quantitative Analysis
 - 6.2.1. Uncalibrated Calculation Procedures
 - 6.2.2. Calibrated Calculation Procedures

Volumetric and Calorimetric Techniques

203

Guido Barone, *University "Federico II" of Naples, Italy*

1. Introduction
2. Volumetric Methods
 - 2.1. Volumetry and Densitometry of Liquids and Solutions
 - 2.2. Densitometry of Solids
3. Calorimetric Methods and Instruments
 - 3.1. Units
 - 3.2. Characteristics of Calorimeters
 - 3.3. Operating Mode Classification Criterion
 - 3.3.1. Adiabatic Calorimeters
 - 3.3.2. Isothermal Calorimeters
 - 3.3.3. Isoperibolic Calorimeters
 - 3.4. Measuring Method Classification Criterion
 - 3.4.1. Power Compensation Quasi-Adiabatic Calorimeters
 - 3.4.2. Differential Power Scanning Calorimeters
 - 3.4.3. Power Compensation Isothermal Calorimeters
 - 3.4.4. Heat Conduction Quasi-Isothermal and Isoperibolic Calorimeters
 - 3.4.5. Differential Temperature Scanning Calorimeters
 - 3.5. Other Kinds of Calorimeters
 - 3.6. Instruments for Thermal Analysis
4. Applications in Life Sciences
 - 4.1. Molecular Studies
 - 4.2. Cellular Studies
 - 4.3. Applications in the Biotechnologies

NMR Spectroscopy

226

Juan Carlos Paniagua, *University of Barcelona, Spain*Miquel Pons, *University of Barcelona, Spain*

1. Introduction
2. Classical Description
3. Quantum Description
4. Multidimensional NMR
5. Dynamic Aspects of NMR
6. Spatial Information from NMR

7. Solid, Liquid, and Partially Oriented Samples
8. The Impact of NMR

Schrödinger Equation and Quantum Chemistry

258

Renato Colle, *Dipartimento di Chimica Applicata, Università di Bologna, Italy*

1. Introduction
2. The Schrödinger Equation
 - 2.1. Foundation of Wave Mechanics
 - 2.2. Properties of the Schrödinger Equation
 - 2.3. Generalization of the Schrödinger Equation for Many-body Systems
 - 2.4. General remarks on the Schrödinger Equation
3. Quantum Chemistry
 - 3.1. Hartree-Fock Theory and Molecular Orbitals
 - 3.2. Correlated Wavefunctions
 - 3.3. Density Functional Theory
 - 3.4. Time-dependent Problems

Molecular Energetics: Valence Bond and Molecular Orbital Methods. Density Functional Theory of Atoms and Molecules

300

Renato Colle, *Dipartimento di Chimica Applicata, Università di Bologna, Italy*

1. Introduction
2. Methods for Obtaining Approximate Electronic Wavefunctions
 - 2.1. One-determinant Approximation and the Hartree-Fock Theory
 - 2.2. Many-determinant Wavefunctions
3. Density Functional Theory of Atoms and Molecules

Molecular Dynamics: Collisional and Statistical Approach to Reaction Rate

331

Vincenzo Aquilanti, *Università di Perugia, Italy*

1. Introduction
2. Definitions and Models
 - 2.1. Cross Section for Reactive Collisions
 - 2.2. From Cross Sections to Rate Constants
3. Theoretical Aspects of Collision Dynamics
 - 3.1. Nature of Collisions
 - 3.2. Classical Models and Quantum Treatments
4. Experimental Techniques
5. Phenomenology
6. Conclusions: From the Dynamics of Elementary Processes to the Modeling of Complex Systems

Optimal Control of Molecular Scale Phenomena

348

Constantin Brif, *Department of Chemistry, Princeton University, USA*

Herschel A. Rabitz, *Department of Chemistry, Princeton University, USA*

1. Introduction
2. Theoretical Principles of Quantum Control
 - 2.1. Control via Two-Path Quantum Interference
 - 2.2. Control with the Pump-Dump Technique
 - 2.3. Optimal Quantum Control
 - 2.4. Tracking Control
 - 2.5. Controllability of Quantum Systems
 - 2.6. Existence and Robustness of Optimal Control

3. Quantum Learning Control
 - 3.1. Structure of Laboratory Learning Control
 - 3.2. Learning Algorithms
4. Laboratory Realizations of Quantum Control
 - 4.1. Manipulations via Laser-Induced Two-Pathway Interferences
 - 4.2. Manipulations with Ultrashort Laser Pulses
 - 4.3. Closed-Loop Laboratory Learning Control
5. Control-Assisted Extraction of Microscopic Information
6. The Future of Quantum Control

Thermodynamic Systems and State Functions

371

Maurizio Masi, *Politecnico di Milano, Italy*

1. Introduction and Historical Perspectives
2. Thermodynamic Systems
3. Internal Energy and First Law of Thermodynamics
4. Thermodynamic Equilibrium and Second Law of Thermodynamics
5. Equilibrium Conditions in Simple Systems
 - 5.1. Thermal Equilibrium
 - 5.2. Mechanical Equilibrium
 - 5.3. Chemical Equilibrium
6. Graphical Representation of Equilibrium States
7. Stability of Thermodynamic Equilibrium States
8. Eulero and Gibbs–Duhem Equations
9. Entropy and Transformation of Heat into Work
 - 9.1. The Carnot Cycle
 - 9.2. Common Thermodynamic Cycles
10. Entropy and its Absolute Value: Third Law of Thermodynamics
11. Other State Functions for Equilibrium Conditions in Chemical Systems: Enthalpy and Free Energies
 - 11.1. Free Energy at Constant Volume or Helmholtz Potential
 - 11.2. Free Energy at Constant Pressure or Gibbs Potential
12. Relationships among State Functions
13. State Functions for Multicomponent Systems: Molar and Partial Molar Functions

Index

411

About EOLSS

423

VOLUME II

Energy Balance of Reacting Systems

1

Maurizio Masi, *Politecnico di Milano, Italy*

1. Introduction
2. Historical Perspectives
3. Rules for Writing Down the Energy Balance
4. Energetic Properties of Chemical Reactions
 - 4.1. Measurements of Internal Energy and Enthalpy Changes
 - 4.2. Application to Reacting Systems: Standard Values
 - 4.3. Heat of Formation and Heat of Combustion
 - 4.4. Thermochemical Laws
5. Calculation of State Functions Involved in Energy Balances
6. Evidencing Reactions' Contributions to Energy Balances

Equilibrium in Multiphase Reacting Systems**21**Renato Rota, *Dipartimento Di Chimica Materiali Ingegneria Chimica, Politecnico di Milano, Italy*

1. Introduction
2. Equilibrium conditions from thermodynamic laws
 - 2.1. Alternative relations
 - 2.2. Closed system constraint
 - 2.2.1. Non-reacting systems: phase equilibrium problem
 - 2.3. Uniformity of temperature and pressure
 - 2.4. Formulation of the equilibrium problem
 - 2.4.1. Stoichiometric approach
 - 2.4.2. Non-stoichiometric approach
 - 2.4.3. Non-reacting systems: phase equilibrium problem
3. The phase rule and the Duhem's theorem
4. The chemical potential
 - 4.1. Single-component ideal-gas
 - 4.2. Single-component non-ideal compounds
 - 4.2.1. Fugacity coefficients of pure species from volumetric equations of state
 - 4.2.2. Fugacity coefficients of pure species in condensed phases: an alternative approach
 - 4.3. Ideal-gas multi-component solution
 - 4.4. Multi-component ideal-solution
 - 4.4.1. Raoult convention
 - 4.4.2. Henry convention
 - 4.5. Non-ideal multi-component solution
 - 4.5.1. Raoult convention
 - 4.5.2. Henry convention
 - 4.6. Activity models
 - 4.6.1. Activity from activity coefficient models
 - 4.6.2. Activity from equations of state
5. Equilibrium constant
 - 5.1. Reference chemical potentials and ΔG_j^R
6. Applications
 - 6.1. Reacting systems without phase equilibrium
 - 6.2. Non-reacting systems
 - 6.2.1. Vapor-liquid equilibrium
 - 6.2.2. Liquid-liquid equilibrium
 - 6.2.3. Solid-liquid equilibrium
 - 6.3. Equilibrium in multiphase reacting systems

Statistical Approach to Thermodynamics**93**Sergio Carra, *Dipartimento di Chimica Fisica Applicata, Politecnico di Milano, Via Mancinelli, 7 – 20132 Milano Italy*

1. Introduction
2. Microscopic behaviour of ideal gases
3. Internal energy and zero point energy
4. Statistical interpretation of the first law of thermodynamics
5. Probability, entropy and laws of thermodynamics
6. Properties of the ideal monoatomic gas
7. Boltzmann distribution law
8. Translational partition function
9. Gibbs approach to statistical mechanics
10. Ideal polyatomic gases
11. Monoatomic solids
12. Interacting systems

13. Charged particle systems
14. Stability of matter
15. General treatment of real fluids
16. Phase Transitions

Irreversible Processes: Phenomenological and Statistical Approach **144**

Carlo Cercignani, *Dipartimento di Matematica, Politecnico di Milano, Milano, Italy*

1. Introduction
2. The Boltzmann Equation
3. Transport Coefficient for Gaseous Mixtures
4. Onsager's Reciprocity Relations from the Boltzmann Equation
5. The Macroscopic Theory of Irreversible Processes
6. The Reciprocity Relations
7. Irreversibility, Patterns and Chaos

Rates of Chemical Reactions: Their Measurement and Mathematical Expressions **163**

Paolo Beltrame, *University of Milano, Italy*

1. Reaction Rate, Kinetic Equation, Catalysis
 - 1.1. Definitions
 - 1.2. Simple Reactions
 - 1.3. Complex Reactions
 - 1.3.1. Opposing Reactions
 - 1.3.2. Parallel Reactions
 - 1.3.3. Consecutive Reactions
 - 1.4. Catalytic Reactions
 - 1.4.1. Homogeneous Catalysis
 - 1.4.2. Enzymatic Catalysis
 - 1.4.3. Heterogeneous Catalysis
2. Dependence of the Rate on Temperature
3. Measurement of Rates
 - 3.1. Measurement by Discontinuous Methods
 - 3.2. Measurement by Continuous Methods

Microkinetics versus Macrokinetics: The Role of Transport Phenomena in Determining Reactions Rates **195**

Renato Rota, *Polytechnic of Milano, Italy*

1. Summary of Basic Concepts
 - 1.1. Rates of Reaction and Production
 - 1.2. Mass-Transfer Rates
 - 1.3. Microkinetics and Macrokinetics
 - 1.4. A Simple Example of Microkinetics Versus Macrokinetics: First-Order Heterogeneous Reactions
2. Fluid-Solid Interphase Diffusion and Reactions
 - 2.1. First-Order Single Irreversible Reaction
 - 2.2. Positive-Order Single Irreversible Reactions
 - 2.3. Negative-Order Single Irreversible Reactions
 - 2.4. First-Order Irreversible Consecutive Reactions
 - 2.5. Simultaneous Irreversible Reactions of n-th Order
 - 2.6. First-Order Irreversible Parallel Reactions
3. Intraphase Diffusion and Reactions
 - 3.1. Intraphase Diffusion and Reactions in Particles and Drops
 - 3.2. Interphase and Intraphase Diffusion and Reactions in Particles and Drops

4. Fluid-Fluid Homogeneous Reactions
 - 4.1. Irreversible Pseudo-First-Order Reactions
 - 4.1.1. Fast Reactions
 - 4.1.2. Slow Reactions

Dynamic Behavior of Complex Reacting Systems: Role of Non-Linearity 232
 Sergio Carra, *Dipartimento di Chimica Fisica Applicata, Politecnico di Milano, Italy*

1. Introduction
2. Rate Law of Chemical Reactions
3. Material and Energy Balances of Reacting Systems
4. Simulation of Stationary Plug Flow Reactors
5. Dynamic Treatment of a Reacting System
6. Steady States and their Stability
7. Autocatalytic Processes
8. Analogies with Phase Transitions and Critical Phenomena
9. Turing Patterns and Self-Organization
10. Symmetry Breaking in Chemical Reacting Systems

Inorganic and Metal-Organic Synthesis 259
 Fausto Calderazzo, *University of Pisa, Italy*

1. Introduction
2. General Properties
 - 2.1. Bonding
 - 2.2. Ligand-Exchange Reactions
3. Descriptive Chemistry
 - 3.1. Hydrogen as Donor Atom
 - 3.1.1. Classical Hydrides
 - 3.1.2. Nonclassical Hydrides
 - 3.2. Carbon as Donor Atom
 - 3.3. Nitrogen as Donor Atom
 - 3.4. Phosphorus as Donor Atom
 - 3.5. Oxygen as Donor Atom
 - 3.6. Sulfur as Donor Atom
 - 3.7. Halogen as Donor Atom

Organic Synthesis 322
 Gian Paolo Chiusoli, *University of Parma, Italy*

1. Introduction
2. Organic Reactions
 - 2.1. Reactions of Nucleophilic Reagents with Electrophilic Substrates
 - 2.2. Reactions of Electrophilic Reagents with Nucleophilic Substrates
 - 2.3. Electrocyclic Reactions
 - 2.4. Metallacyclic Reactions: Metathesis
3. Rate and Selectivity Control
 - 3.1. Rational Use of Chemical and Physical Parameters
 - 3.2. Catalysis
 - 3.3. Selectivity
 - 3.4. Asymmetric Synthesis
 - 3.5. Protective Groups
 - 3.6. Heterogeneous and Solid-State Reactions
 - 3.7. Phase-Transfer Techniques
 - 3.8. Syntheses in Special Fluids

- 3.8.1. Synthesis in Fluorous Phase
- 3.8.2. Synthesis in Supercritical Fluids
- 3.8.3. Synthesis in Ionic Liquids
- 3.9. Photochemical Synthesis
- 3.10. Electrochemical Synthesis
- 4. Multistep Reactions
 - 4.1. Oligomerization and Polymerization of Organic Compounds
 - 4.2. Stepwise Reactions Involving Group Protection and Deprotection
 - 4.3. Chain-Growth Organic Reactions
- 5. Organic Synthesis based on Weak Interactions: Self-Assembly
- 6. Bio-Inspired Organic Synthesis
 - 6.1. Enzyme Models
 - 6.2. Antibody-Catalyzed Reactions
 - 6.3. Self-Replication
 - 6.4. Amplification of Chirality
- 7. Synthetic Planning and Strategies
 - 7.1. Target Identification and Modeling
 - 7.1.1. New Structures
 - 7.1.2. New Structures with Function
 - 7.2. Combinatorial Chemistry
 - 7.3. Retrosynthetic Analysis
 - 7.4. Total Synthesis
- 8. Perspectives

Synthesis of Nanophases**362**Carlo Cavallotti, *Politecnico di Milano, Italy*

- 1. Structure and Properties of Nanophases
- 2. Synthesis of Quantum Wells
 - 2.1. Growth Methods
 - 2.2. Atomistic Aspects of Surface Growth
 - 2.3. Superlattice Structures
- 3. Synthesis of Quantum Wires
 - 3.1. Growth on Stepped Surfaces
 - 3.2. Stress-Assisted Nanowire Formation
 - 3.3. Laser Formation and Recrystallization of Nanoparticles
 - 3.4. Formation and Filling of Nanotubes
- 4. Synthesis of Quantum Dots
 - 4.1. Epitaxial Growth
 - 4.2. Colloidal Chemistry

Polymers and their Synthesis**379**F. Ciardelli, *Dipartimento di Chimica e Chimica Industriale, Università di Pisa, Italy.*E. Passaglia, *CNR-ICCOM Sezione di Pisa, Italy*S. Bronco, *CNR-INFN PloyLab Pisa Italy*

- 1. Introduction
 - 1.1. Historical aspects
 - 1.2. Chemical structure
 - 1.3. Stereochemical structure
 - 1.4. Typical examples
- 2. The synthesis of macromolecules
 - 2.1. From monomers to macromolecules
 - 2.1.1. Features of the polymerisation reactions
 - 2.1.2. Chain polymerizations
 - 2.1.3. Stepwise polymerization

- 2.2. From macromolecules to macromolecules
 - 2.2.1. Change of molecular weight
 - 2.2.2. Postmodification
- 3. The shape of macromolecules
- 4. The crystalline and the amorphous state
- 5. Application of polymers
 - 5.1. Polymers for structural applications
 - 5.1.1. Polymeric materials
 - 5.1.2. Additives
 - 5.1.3. Forming
 - 5.2. Polymers for functional applications (speciality polymers)

Biochemical Methods of Synthesis

422

Bruno Botta, *Università degli Studi “La Sapienza,” Rome, Italy*
 Sandro Cacchi, *Università degli Studi “La Sapienza,” Rome, Italy*

- 1. Introduction
- 2. Early Employment of Enzymes in Organic Synthesis
- 3. Biotransformations in Organic Synthesis
 - 3.1. Hydrolytic Reactions
 - 3.2. Oxydation and Reduction Reactions
 - 3.2.1. Cofactor Recycling
 - 3.2.2. Reduction of Aldehydes, Ketones, and Derivatives
 - 3.2.3. Oxidation
- 4. Carbon–Carbon Bond-Forming Reactions
- 5. Glycosyl-Transfer Reactions
- 6. Halogenation Reactions
- 7. Abzyme-Catalyzed Reactions
- 8. Reactions Catalyzed by Artificial Enzymes

Index

449

About EOLSS

459