

# HANDBOOK OF LASERS

## TABLE OF CONTENTS

### PREFACE

### SECTION 1: SOLID STATE LASERS

- 1.0 Introduction
- 1.1 Crystalline Paramagnetic Ion Lasers
  - 1.1.1 Introduction
  - 1.1.2 Host Crystals Used for Transition Metal Laser Ions
  - 1.1.3 Host Crystals Used for Lanthanide Laser Ions
  - 1.1.4 Tables of Transition Metal Ion Lasers
  - 1.1.5 Tables of Divalent Lanthanide Ion Lasers
  - 1.1.6 Tables of Trivalent Lanthanide Ion Lasers
  - 1.1.7 Actinide Ion Lasers
  - 1.1.8 Other Ions Exhibiting Gain
  - 1.1.9 Self-Frequency-Doubled Lasers
  - 1.1.10 Commercial Transition Metal Ion Lasers
  - 1.1.11 Commercial Lanthanide Ion Lasers
  - 1.1.12 References
- 1.2 Glass Lasers
  - 1.2.1 Introduction
  - 1.2.2 Tables of Glass Lasers
  - 1.2.3 Glass Amplifiers
  - 1.2.4. Commercial Glass Lasers
  - 1.2.5. References
- 1.3 Solid State Dye Lasers
  - 1.3.1. Introduction
  - 1.3.2. Dye Doped Organic Lasers
  - 1.3.3. Silica and Silica Gel Dye Lasers
  - 1.3.4. Dye Doped Inorganic Crystal Lasers
  - 1.3.5. Dye Doped Glass Lasers
  - 1.3.6. Dye Doped Gelatin Lasers
  - 1.3.7. Dye Doped Biological Lasers
  - 1.3.8. Commercial Solid State Dye Lasers
  - 1.3.9. References
- 1.4 Color Center Lasers
  - 1.4.1 Introduction
  - 1.4.2 Crystals and Centers Used for Color Center Lasers
  - 1.4.3 Table of Color Center Lasers
  - 1.4.4 Commercial Color Center Lasers
  - 1.4.5 References

- 1.5 Semiconductor Lasers
  - 1.5.1 Introduction
  - 1.5.2 II-VI Compound Lasers
  - 1.5.3 Mercury II-VI Compound Lasers
  - 1.5.4 III-V Compound Lasers
  - 1.5.5 III-V Compound Antimonide Lasers
  - 1.5.6 Nitride Lasers
  - 1.5.7 Lead IV-VI Compound Lasers
  - 1.5.8 Germanium-Silicon Intervalence Band Lasers
  - 1.5.9 Other Semiconductor Lasers
  - 1.5.10 Quantum Cascade and Intersubband Lasers
  - 1.5.11 Vertical Cavity Lasers
  - 1.5.12 Commercial Semiconductor Lasers
  - 1.5.13 References
- 1.6 Polymer Lasers
  - 1.6.1 Introduction
  - 1.6.2 Pure Polymer Lasers
  - 1.6.3 Dye Doped Polymer Lasers
  - 1.6.4 Rare Earth Doped Polymer Lasers
- 1.7 Solid State Excimer Lasers
- 1.8 Raman, Brillouin, and Soliton Lasers
  - 1.8.1 Introduction
  - 1.8.2 Crystalline Raman Lasers
  - 1.8.3 Fiber Raman Lasers and Amplifiers
  - 1.8.4 Fiber Soliton Lasers
  - 1.8.5 Fiber Brillouin Lasers
  - 1.8.6 References

## SECTION 2: LIQUID LASERS

- 2.1 Liquid Organic Dye Lasers
  - 2.1.1 Introduction
  - 2.1.2 Chemical Nomenclature
  - 2.1.3 Tables of Liquid Organic Dye Lasers
  - 2.1.4 Commercial Dye Lasers
  - 2.1.5 Dye Laser Tuning Curves
  - 2.1.6 References
- 2.2 Rare Earth Liquid Lasers
  - 2.2.1 Introduction
  - 2.2.2 Chelate Liquid Lasers
  - 2.2.2 Aprotic Liquid Lasers
- 2.3 Liquid Polymer Lasers
- 2.4 Liquid Excimer Lasers

## SECTION 3: GAS LASERS

- 3.0 Introduction
- 3.1 Neutral Atom Gas Lasers
  - 3.1.1 Introduction
  - 3.1.2 Tables of Neutral Atom Gas Lasers
- 3.2 Ionized Gas Lasers
  - 3.2.1 Introduction
  - 3.2.2 Energy Level Diagrams for Ionized Gas Lasers
  - 3.2.3 Tables of Ionized Gas Lasers
- 3.3 Molecular Gas Lasers
  - 3.3.1 Electronic Transition Lasers
  - 3.3.2 Vibrational Transition Lasers
- 3.4 Far Infrared and Millimeter Wave Gas Lasers
  - 3.4.1 Introduction
  - 3.4.2 Tables of Atomic Far Infrared Gas Lasers
  - 3.4.3 Tables of Molecular Far Infrared and Millimeter Wave Gas Lasers
- 3.5. Commercial Gas Lasers
- 3.6 Comments
- 3.7 References

## SECTION 4: OTHER LASERS

- 4.1 Extreme Ultraviolet and Soft X-Ray Lasers
  - 4.1.1 Introduction
  - 4.1.2 Lasing Transitions of H-like Ions
  - 4.1.3 Lasing Transitions of Li-like Ions
  - 4.1.4 Lasing Transitions of Be-like Ions
  - 4.1.5 Lasing Transitions of Ne-like Ions
  - 4.1.6 Lasing Transitions of Co-like Ions
  - 4.1.7 Lasing Transitions of Ni-like Ions
  - 4.1.8 Lasing Transitions of Pd-like Ions
  - 4.1.9 References
- 4.2 Free Electron Lasers
  - 4.2.1 Introduction
  - 4.2.2 Short Wavelength Free Electron Lasers
  - 4.2.3 Long Wavelength Free Electron Lasers
- 4.3 Nuclear Pumped Lasers
  - 4.3.1 Introduction
  - 4.3.2 Reactor Pumped Lasers
  - 4.3.3 Nuclear Device Pumped Lasers
  - 4.3.4 References
- 4.4 Natural Lasers
- 4.5 Inversionless Lasers
- 4.6 Amplification of Core-Valence Luminescence

## APPENDICES

Appendix I Laser Safety

Appendix II Acronyms, Abbreviations, Initialisms, and Common Names for Types of Lasers, Laser Materials, Laser Structures and Operating Configurations, and Systems Involving Lasers

Appendix III Electron Configurations of Neutral Atoms in the Ground State

Appendix IV Fundamental Constants