CONTENTS

Preface

ix	

1 INTRODUCTION 1 1.1 Brief Review of Electron Accelerator Development and Application of Radiation Effect 1 1.2 Types of Radiation and Units of Measurement 6 1.3 Beams of Accelerated Charged Particles: General Concepts 8 1.4 Isotopic Sources 13 1.5 Application of Beams of Accelerated Charged Particles and Other Kinds of Radiation 14

2 INTERACTION OF RADIATION WITH MATTER AND APPLICATIONS OF ELECTRON ACCELERATORS

17

2.1	Ionizing Effect of Electrom Beam	17
2.2	Generation of Bremsstrahlung	22
2.3	Penetration of Bremsstrahlung through Matter	24
2.4	Photonuclear Reactions	25

v

vi		CONTENTS
	2.5 Electric Charge in Materials under Irradiation	27
	2.6 Radiation Defectoscopy	28
	2.7 Activation Analysis	29
	2.8 Maintenance of Non-Self-Maintained Discharge in	
	Electroionization Laser	29
	2.9 Synchrotron Radiation	30
3	CHEMICAL PROCESSES OCCURRING UNDER	
U	THE EFFECT OF IONIZING RADIATION	33
	3.1 Peculiarities of Radiochemical Processes	33
	3.2 Radiation Polymerization	35
	3.3 Radiation Cross-linking of Polymers	40
	3.4 Radiation Destruction of Polymers	46
	3.5 Combination Processes	47 50
	3.6 Processes in Gas-Phase Matter	50
4	IRRADIATION OF BIOLOGICAL OBJECTS	53
	4.1 Physicochemical Basis of Radiobiological Processes	53
	4.2 Sterilization of Medical Materials	55
	4.3 Preservation of Foodstuff	57
	4.4 Deinsectization of Grain	59
	4.5 Presowing Irradiation of Seeds	60
	4.6 Inhibiting Germination of Crops in Storage	60
	4.7 Radiation Selection4.8 Radiation Therapy	61 62
	4.8 Radiation Therapy 4.9 Biomaterials	63
	4.9 Biomaterials 4.10 Sterilization of Sewage	64
5	THERMAL EFFECT OF INTENSE BEAMS ON	
-	MATTER	67
	5.1 Interaction of Intense Electron Flux with Metal	67
	5.2 Technological Processes of Heat Treatment of Metals by Intense	
	Electron Beams	71
	5.3 Treatment of Dielectrics by Accelerated Electrons	78
	5.4 Propagation of Intense Electron Fluxes in Gas	80
	5.5 Comparison of Accelerated Electron Beam and Laser Radiation	81
	5.6 Conclusion	82

CO	NTENTS	vii
6	DIRECT-ACTION ACCELERATORS	85
	6.1 Acceleration of Particles in Potential Electric Field	85
	6.2 Methods for Generating High Voltages	86
	6.3 Electrostatic Generators	89
	6.4 Single-Phase, High-Voltage Transformers	92
	6.5 Direct-Voltage Generators Based on Single-Phase Transformers	109
	6.6 Direct-Voltage, Capacitance-Coupled Cascade Generators	109
	6.7 Direct-Voltage Generators Based on Three-Phase Transformers	122
	6.8 Pulsed Voltage Generators	127
	6.9 Components of High-Voltage Generators	135
	6.10 Accelerating Devices	144
7	INDUCTION AND RESONANCE ELECTRON	
	ACCELERATORS	157
	7.1 Acceleration of Electrons in Vortex Electric Fields7.2 Construction and Power Supply Circuits of Induction Electron	157 167
	Accelerators 7.3 Resonance Acceleration of Electrons	107
	7.4 Electric Circuits and Construction of Resonance Electron	170
	Accelerators	185
8	COMPONENTS OF RADIATION	
	INSTALLATIONS	193
	8.1 Devices for Extraction of Accelerated Electrons from Vacuum	193
	8.2 Targets for Generating Bremsstrahlung	204
	8.3 Radiation Zones and Radiation Shieldings	207
	8.4 Measurement of Beam Parameters and Radiation Dose	214
0	TYPICAL RADIATION FACILITIES BASED ON	
9		
	ELECTRON ACCELERATORS	223
	9.1 Industrial Installations for Electron-Beam Cross-linking of	
	Polyethylene 9.2 Installations for Electron Beam Curing	223
	7.2 Instantations for Electron Deant Curing	231

vii

viii -		CONTENTS
9.3	Installations for Radiation Treatment of Fabrics	237
9.4	Installations for Sterilization and Deinsectization	238
9.5	Installations for Flaw Inspection	242
9.6	Radiotherapy Installations	246
9.7	Miscellaneous Radiation Installations	251
9.8	Prospects of Using the Relativistic Electron Beams in New	
	Fields of Application	255
	NDIXES. Parameters of Electron Accelerators	267
Used 1	for Applied Purposes	267

R	eferences	
77		