

Contents

Preface	iii
1. Introduction	1
1.1 Scope	1
1.2 Purpose	1
1.3 Dose, Dose Rate and Dosimeter	1
1.4 Pulsed Radiation	1
1.5 Time Parameters Defining Pulsed Radiation	2
1.5.1 Time Parameters in Ionization Dosimetry	2
1.5.2 Time Parameters in Chemical Dosimetry	2
1.5.3 Time Structure within the Pulse	3
1.5.4 Specification of Absorbed Dose Rate	3
1.5.5 The Instantaneous Pulse	3
1.6 Pulse Monitoring	3
1.7 High-LET Pulsed Radiation	3
2. Ionization Dosimetry	5
2.1 Bragg-Gray Theory and Ionic Recombination	5
2.2 Calculation of General Recombination at Constant Collecting Voltage	5
2.2.1 Theoretical Assumptions	5
2.2.2 Collection Efficiency in a Plane Parallel Ionization Chamber	5
2.2.3 Collection Efficiency as a Function of the Measured Charge Density	6
2.2.4 Screening Effect of Space Charge	7
2.2.5 Cylindrical or Spherical Ionization Chambers	7
2.2.6 A Two Point Technique for Assessing Collection Efficiency	8
2.2.7 Collection Efficiency in "Swept Beam" Irradiation Techniques	9
2.2.8 The Effect of Overlapping Pulses	9
2.3 Free Electron Collection	11
2.3.1 Plane Parallel Geometry	11
2.3.2 Cylindrical Geometry	11
2.4 Condenser Ionization Chambers	12
2.4.1 Collection Efficiency for a Train of Small Pulses	12
2.4.2 Collection Efficiency for a Single Large Pulse	12
2.4.3 Inapplicability of the Two Point Check on Saturation ..	12
2.5 Vacuum Ionization Monitors (SEMIRAD)	12
2.6 The Use of Single Particle Detectors	13
2.7 The Design of Ionization Chambers for Pulsed Radiation	13
2.7.1 Example of a Design for 0.01 Gy Per Pulse	13
3. Chemical Dosimetry	14
3.1 Reactions During and After a Short Pulse of Radiation	14
3.2 The Radiation-Chemical Yield $G(x)$	14
3.3 The Fricke Dosimeter	15
3.4 Systems Suitable for Large Absorbed Dose Per Pulse	16
3.5 Dosimetry by the Optical Absorption of Radicals or Other Transient Species	17
3.5.1 Measuring Methods	17
3.5.2 Correction for Pulse Duration	17
3.5.3 Correction for System Response Time	18
3.6 Practical Radical Dosimetry Systems	19
3.6.1 The Thiocyanate Dosimeter	19
3.6.2 The Hydrated Electron Dosimeter	20
3.6.3 The Ferrocyanide Dosimeter	21
3.6.4 The Fricke Dosimeter	21
4. Calorimetric Dosimetry of Pulsed Radiation	22
4.1 Advantages	22
4.2 Limitations	22
4.3 Scope of this Section	22
4.4 The Calorimeter	22
4.4.1 Temperature Rise of the Absorbing Medium	22
4.4.2 Temperature Rise of the Sensor	22
4.4.3 Equilibration Time of the Sensor	23
4.4.4 Transmission Monitors	26

4.5	Practical Calorimetric Systems	26
4.5.1	Adiabatic Calorimetry	26
4.5.2	Dosimetry of Gaseous Samples	27
4.5.3	Calorimetry by Conductivity Change	27
4.5.4	Holographic Calorimetry	27
4.5.5	Absorbed Dose Distribution in a Water Phantom	27
4.5.6	The Thermal Defect in Calorimetry	28
4.5.7	Calorimetry in Radiobiology	28
4.5.8	Monitors for Single Pulses	29
5.	Solid State Dosimetry Systems	31
5.1	Advantages and Limitations	31
5.2	Classes of Dosimeter	31
5.3	Integrating Dosimeters	31
5.3.1	Choice of a System	32
5.4	Systems Capable of Repeated Readout	32
5.4.1	Optical Absorption	32
5.4.2	Luminescent Systems	33
5.5	Systems Permitting Only Single Readout	34
5.6	Systems Indicating Absorbed Dose Rate	34
5.6.1	Semiconductor Devices	34
5.6.2	Semiconductors Operated with an Applied Potential	34
5.6.3	Semiconductors Operated with No External Applied Field	35
5.7	Checking a System for Linearity of Response	35
6.	Summary	36
6.1	Ionization Dosimetry	36
6.2	Chemical Dosimetry	36
6.3	Calorimetric Dosimetry	36
6.4	Solid State Systems	36
	Appendix: Ionic Mobilities and Recombination Coefficient:	
	The Value of μ	37
	References	38
	ICRU Reports	43
	Index	46