



# *Contents*

List of contributors	ix
Preface	xi

## **Part I: Fundamentals**

<b>1 History</b>	<b>3</b>
A SCHARMANN	
<b>2 Theory</b>	
M BÖHM AND A SCHARMANN	11
2.1 Introduction	11
2.2 Excitation by radiation	11
2.3 Thermal excitation and recombination	16
2.4 Phenomenological analysis	18
2.5 Kinetic models	21
2.6 Determination of trap parameters	24
2.7 Additional parameters	26
2.8 Computer simulation	30
2.9 Comparison with experiment	32
2.10 Conclusions	36
<b>3 Instrumentation</b>	<b>39</b>
H W JULIUS	
3.1 Introduction	39
3.2 The heating system	40
3.3 The light detecting system	48
3.4 Special items	52
3.5 TLD readers and systems	53
3.6 Address list	64

<b>4 Accessory instrumentation</b>	<b>67</b>
<b>M OBERHOFER</b>	
4.1 Introduction	67
4.2 Heating planchets	67
4.3 Gas flushing	69
4.4 Reference light sources	70
4.5 Powder dispensers	71
4.6 Mechanical tweezers	74
4.7 Vacuum tweezers	74
4.8 Sieves	75
4.9 Ultrasonic cleaners	75
4.10 Annealing furnaces	76
4.11 Annealing stands	77
4.12 Irradiators	79
4.13 Literature	80
<b>5 General characteristics of TL materials</b>	<b>83</b>
<b>G BUSUOLI</b>	
5.1 Introduction	83
5.2 Linearity	83
5.3 Response to photons	86
5.4 Response to beta rays	88
5.5 Response to neutrons	89
5.6 Fading	91
5.7 Annealing procedures	93
5.8 Stability and reproducibility	94
5.9 Dose rate dependence	95
5.10 Tribothermoluminescence (or triboluminescence)	95
<b>6 Preparation and properties of principal TL products</b>	<b>97</b>
<b>G PORTAL</b>	
6.1 Introduction	97
6.2 Lithium fluoride	97
6.3 Lithium borate	106
6.4 Beryllium oxide	109
6.5 Calcium fluoride	111
6.6 Calcium sulphate	115
6.7 Aluminium oxide	118
<b>7 Operational aspects</b>	<b>123</b>
<b>D F REGULLA</b>	
7.1 Introduction	123

7.2 Parameters affecting precision	124
7.3 Conclusion	140
<b>8 Precision and accuracy of TLD measurements</b>	<b>143</b>
<b>G BUSUOLI</b>	
8.1 Introduction	143
8.2 Definitions	143
8.3 Assessment of random and systematic uncertainties	143
8.4 Sources of errors in TLD	145
8.5 Precision of TL measurements	146
8.6 Accuracy of TL measurements	149
8.7 Accuracy in low-dose measurements	150
<b>9 Reference to other solid-state methods</b>	<b>151</b>
<b>E PITT AND A SCHARMANN</b>	
9.1 Introduction	151
9.2 Radiophotoluminescence (RPL)	153
9.3 Colouring	155
9.4 Photographic processes	156
9.5 Stimulated exoelectron emission	157
9.6 Track detection	159
9.7 Change of resistance in silicon diodes	161
9.8 Scintillation dosimeter	163
9.9 Conclusions	163
<b>Part II: Applications</b>	
<b>10 Application of TLD to personnel dosimetry</b>	<b>167</b>
<b>E PIESCH</b>	
10.1 Introduction	167
10.2 Performance specifications	168
10.3 Detector materials and specific requirements	170
10.4 Personnel dosimeter systems	177
10.5 Special applications	182
10.6 Future trends	192
<b>11 Application of TLD systems for environmental monitoring</b>	<b>197</b>
<b>E PIESCH</b>	
11.1 Introduction	197
11.2 Performance specifications	198
11.3 Properties of commercial TLD systems	198

11.4 Calibration technique for dosimeter batch and reader	214
11.5 Reproducibility and overall uncertainty of measurement	219
11.6 Interpretation of field exposures	220
11.7 Practical application	224
<b>12 Applications of TL materials in neutron dosimetry</b>	<b>229</b>
<b>J A DOUGLAS</b>	
12.1 Introduction	229
12.2 Neutrons and dosimetry	229
12.3 Thermal neutron detectors	232
12.4 Intermediate and fast neutron dosimeters	241
12.5 Possible future developments	253
<b>13 Glow-curve analysis</b>	<b>259</b>
<b>A C LUCAS</b>	
13.1 Introduction	259
13.2 Recording of glow curves	259
13.3 Measurement of neutron dose equivalent	261
13.4 Beta-ray measurement	265
13.5 Fading correction	266
13.6 Determination of time from exposure	268
13.7 Verification of data	269
<b>14 Application of TLD in medicine</b>	<b>271</b>
<b>A F MCKINLAY</b>	
14.1 Radiotherapy measurements	271
14.2 Diagnostic radiology measurements	271
14.3 Factors in the choice of dosimeters for clinical use	273
14.4 Radiotherapy absorbed dose measurements	279
14.5 Examples of the use of TL dosimeters in radiotherapy	283
14.6 Diagnostic radiology absorbed dose measurements	284
<b>15 Application of TLD in biology and related fields</b>	<b>289</b>
<b>M OBERHOFER</b>	
15.1 Introduction	289
15.2 Animal experiments	289
15.3 Bone dosimetry	290
15.4 Photon radiation quality measurements	291
15.5 Toxicity determinations	292
15.6 General biology and biochemistry	293
15.7 Ecology	293
15.8 Animal habit studies	295

<b>16 High-level photon dosimetry with TLD materials</b>	<b>297</b>
<b>M OBERHOFER</b>	
16.1 Introduction	297
16.2 Lithium fluoride	298
16.3 Lithium borate	306
16.4 Calcium fluoride	308
16.5 Other TLD phosphors	308
16.6 Final remarks	310
<b>17 Application of TLD in reactor engineering</b>	<b>315</b>
<b>J R A LAKEY</b>	
17.1 Introduction	315
17.2 A survey of the application of TL in reactor environments	316
17.3 Application to neutron dosimetry	327
17.4 Environmental monitoring	331
17.5 Miscellaneous applications	333
Appendix 17.1 Calculation of gamma photon absorbed dose	333
Appendix 17.2 Cavity ionisation theory	337
Appendix 17.3 The intrinsic TL response per absorbed neutron	340
<b>18 Application of TLD for dating: a review</b>	<b>347</b>
<b>G A WAGNER</b>	
18.1 Introduction	347
18.2 Dating method	347
18.3 Dating applications	352
18.4 Conclusion	355
<b>19 TL dating: techniques and problems</b>	<b>361</b>
<b>M JAITKEN</b>	
19.1 Introduction	361
19.2 Application	365
19.3 Recent research and outstanding problems	369
<b>20 Application of TL dosimeters in dose standardisation and intercomparison</b>	<b>383</b>
<b>G SCARPA</b>	
20.1 Introduction	383
20.2 Dissemination of standards	383
20.3 Direct intercomparison methods	384
20.4 Characteristics of TL dosimeters used for mailed intercomparisons	386
20.5 Practical examples of mailed intercomparisons	386
20.6 Conclusions	390

<b>Appendix</b>	<b>The new radiological (SI) units and their conversion to the units previously used</b>	<b>391</b>
<b>Index</b>		<b>393</b>

