Contents

Preface *ix*
Acknowledgement *xi*
Glossary of Key Terms *xiii*
About the Companion Website *xv*

Introduction *1*

1 Assessment of Mechanical Properties of Dental Restorative Materials *3*
1.1 Tensile Strength *5*
1.2 Diametral Compression Test *7*
1.3 Compressive Strength *7*
1.4 Flexural Strength *8*
1.5 Resistance to Fatigue *9*
1.6 Hardness *10*
1.7 Elastic Modulus *14*
1.8 Fracture Toughness *14*
1.9 Nanoindentation *15*
1.10 Bond Strength *15*
1.10.1 Macro-Test Methods *15*
1.10.1.1 Macro-Shear (SBS) Test *16*
1.10.1.2 Macro-Tensile (TBS) Test *16*
1.10.1.3 Push-Out (PO) Test *16*
1.10.2 Micro-Test Methods *16*
1.10.2.1 Micro Shear Test *16*
1.10.2.2 Micro Tensile Test *16*
1.10.2.3 Micro Push-Out Bond Strength *16*
References *17*

2 Assessment of Physical Properties of Dental Restorative Materials *19*
2.1 Assessment of Surface Roughness *19*
2.1.1 Mechanical Stylus Method *20*
2.1.2 Optical Method *21*

COPYRIGHTED MATERIAL

2.1.2.1 Taper-Sectioning Method *22*
2.1.2.2 Light-Sectioning Method *22*
2.1.2.3 Specular Reflection Methods *22*
2.1.2.4 Diffuse Reflection (Scattering) Methods *24*
2.1.2.5 Speckle Pattern Method *24*
2.1.2.6 Optical Interference Methods *25*
2.1.2.7 A Commercial Digital Optical Profiler *25*
2.1.2.8 Scanning Probe Microscopy (SPM) Methods *26*
2.1.2.9 Scanning Tunneling Microscopy (STM) *26*
2.1.2.10 Atomic Force Microscopy (AFM) *28*
2.2 Water Sorption and Solubility *29*
2.3 Viscosity *29*
2.3.1 U-Tube Viscometers *30*
2.3.2 Falling Sphere Viscometers *31*
2.3.3 Brookfield's Viscometer *31*
2.4 Surface Tension *31*
2.5 Degree of Conversion *33*
2.6 Microleakage *34*
2.6.1 Methods Used for Detection of Microleakage *34*
2.6.2 Air Pressure *34*
2.6.3 Fluid Filtration *35*
2.6.4 Neutron Activation Analysis *35*
2.6.5 Electrical Conductivity *36*
2.6.6 Bacteria *36*
2.6.7 Artificial Caries *37*
2.6.8 Radioactive Tracers *37*
2.6.9 Chemical Tracers *38*
2.6.10 Dyes *38*
2.6.11 Dye Extraction Technique *40*
2.6.12 Scanning Electron Microscopy (SEM) *40*
2.6.13 Confocal Laser Scanning Microscopy *41*
2.6.14 Micro-CT *41*
2.6.15 Optical Coherence Tomography *42*
2.7 Interfacial Adaptation and Film Thickness *42*
2.8 Radiopacity *43*
References *44*

3 Isolation and Identification of Oral Microflora *49*
3.1 Isolation and Identification *50*
3.2 Steps for Conducting an Experiment for Microbial Isolation and Identification *50*
3.2.1 Sample Collection *51*
3.2.2 Transportation of Samples for Testing *51*
3.2.3 Suspension and Dilution of Samples *52*
3.2.4 Inoculation and Incubation of Samples *53*
3.2.5 Identification of Microflora *55*

3.3 Molecular Biological Methods for Microflora Identification *57*
3.3.1 Polymerase Chain Reaction *58*
3.3.2 DNA–DNA Hybridization *60*
3.3.3 Fluorescence in Situ Hybridization *60*
3.3.4 Terminal-RFLP *61*
3.3.5 DNA Microarrays *62*
References *64*

4 Assessment of Biocompatibility of Dental Materials *67*
4.1 Standards for Testing Biocompatibility *67*
4.1.1 ANSI/ADA 41 *68*
4.1.2 ISO 10993 *68*
4.1.3 ISO 7405 *69*
4.2 Testing Hierarchy *69*
4.2.1 Linear Progression *69*
4.2.2 Nonlinear Progression *69*
4.3 Initial Tests for Assessment of Biocompatibility *70*
4.3.1 Direct Cell Culture Test *71*
4.3.1.1 Dye Exclusion Assays *71*
4.3.1.2 Colorimetric Assays *72*
4.3.1.3 Fluorometric Assays *79*
4.3.1.4 Luminometric Assays *81*
4.3.2 Barrier Screening Test *83*
4.3.3 Agar Diffusion Test *83*
4.3.4 Filter Diffusion Testing Method *83*
4.3.5 Tooth Slice Culture Assay *84*
4.3.6 Micronuclei Test *84*
4.3.7 Ame's Test *84*
4.3.8 Style's Test *84*
4.3.9 Hemolysis Test *84*
4.4 Animal Tests *85*
4.4.1 Inhalation Test *85*
4.4.2 Implantation Test *85*
4.4.3 Maximization Test *86*
4.4.4 Buehler's Test *86*
4.5 Usage Tests *86*
4.5.1 Pulp–Dentin Test for Restorative Materials *86*
4.5.2 Pulp Capping and Pulpotomy Material Test *86*
4.5.3 Mucosal Damage and Mucosa Usage Test *87*
4.5.4 Periapical Tissue Damage and Endodontic Usage Test *87*
4.5.5 Gingival Usage Test *87*
4.5.6 Teratogenic Effects and Influence on Reproduction *87*
4.5.7 Clinical Trials *87*
4.5.7.1 Clinical Testing of Restorative Materials *88*
4.5.7.2 Allergy Tests *88*
References *91*

5 Assessment of Optical Properties *95*
5.1 Perception of Color *95*
5.2 Three Dimensions of Color *96*
5.2.1 Hue *96*
5.2.2 Value *97*
5.2.3 Chroma *97*
5.3 Color Measurements *99*
5.3.1 Visual Color Measurement *99*
5.3.2 Instrumental Color Measurement *99*
5.4 Experimental Design for the Assessment of Color Stability *101*
5.4.1 Sample Preparation for Color Stability Assessment *102*
5.4.2 Staining Procedure *102*
5.4.3 Assessment of Color Change *102*
5.5 Test for Color Stability of Composite Resin (Pictorial Representation) *105*
5.6 Assessment of Fluorescence *109*
5.6.1 Fluorescnece of Natural Teeth *109*
5.6.2 Fluorescence of Restorative Materials *109*
5.6.3 Measurement of Fluorescence *110*
5.7 Assessment of Gloss *111*
References *113*

6 Simulation of Oral Environment *117*
6.1 Strain Gauge Transducers *120*
6.2 Piezoelectric Transducers *120*
6.3 Pressure Transducers *120*
6.4 Cyclic Loading Apparatus *121*
References *125*

7 Extra Mile: Biofilm Models and Assessment of Biofilms in Restorative Dentistry *127*
7.1 Difference Between Dental Plaque and Biofilm *128*
7.2 Virulence Factors of Biofilms *128*
7.3 Biofilm Formation *129*
7.4 Microorganisms in Oral Biofilms *129*
7.5 In vitro Biofilm Models *129*
7.5.1 Static Biofilm Models *130*
7.5.2 Dynamic Biofilm Models *130*
7.6 Applications of In vitro Biofilm Models *131*
7.7 Factors Affecting Biofilm Adhesion to Restorative Materials *131*
7.8 Sample Preparation for Biofilm Study on Restorative Materials *131*
7.9 Use of Biofilm Assays *132*
7.10 Biofilm Formation on Restorative Materials *132*
References *133*

Index *135*