

Table of Contents

Acknowledgements.....	xii
Abstract.....	xiii
1 Introduction	1
References	5
2 Literature Survey	7
2.1 Ceramic Materials.....	7
2.2 Zirconia and its Polymorphs	7
2.2.1 Stabilization of Zirconia and its Advantages	8
2.3 Applications of Zirconia Ceramics	10
2.3.1 Zirconia as a Dental Material	10
2.3.2 Zirconia Based Refractory Materials	11
2.3.3 Zirconia in Cutting Tools Industry.....	12
2.4 Composite Materials.....	12
2.5 Ceramic Matrix Composites (CMCs).....	12
2.6 Zirconia-Alumina Composites.....	13
2.7 Fiber Reinforced Ceramic Composites.....	14
2.8 Hydrothermal Synthesis	15
2.8.1 Brief History	15
2.8.2 What is Hydrothermal Synthesis.....	16
2.8.3 The Merits of Hydrothermal Synthesis.....	18
2.8.4 Synthesis of Alumina Whiskers	18
2.9 Deflocculant and Dispersion of Reinforcement in Composite	19
2.10 Hydroxyapatite for Improving Biocompatibility	20
2.10.1 Hydroxyapatite and its Preparation	20
2.10.2 Hydroxyapatite for Bio-Composites.....	21
2.11 Solid-State Sintering.....	22
2.11.1 Sintering of Whisker Reinforced Composites.....	23
2.12 Concluding Remarks and Objective of the Thesis.....	24
References	26
3 Characterization Techniques	38
3.1 A Brief Outline of Synthesis Processes	38
3.2 Characterization Techniques	38
3.2.1 X-Ray Diffraction.....	39
3.2.2 Scanning Electron Microscopy	40
3.2.3 Fourier Transform Infrared Spectroscopy (FTIR).....	41
3.2.4 Thermogravimetric Analysis (TGA).....	41
3.2.5 Mechanical Properties.....	42
3.2.6 In-Vitro Biocompatibility Study	46
References	48
4 Hydrothermal Synthesis of AACH Whiskers	50
4.1 Experimental Procedure	51
4.1.1 Hydrothermal Synthesis of AACH Whiskers	51
4.2 Results and Discussion	53
4.2.1 Fourier Transform Infrared Spectroscopy.....	60
4.3 Conclusions	62
References	63
5 Effect of Deflocculants on the Properties of Composite	66
5.1 Experimental Procedures	68
5.1.1 Preparation of AACH Whiskers.....	68
5.1.2 Synthesis & Characterization of TZ-3Y+Al ₂ O ₃ Composites	68
5.2 Results	70

5.2.1	<i>AACH Whiskers, Alumina Powder & Tetragonal Zirconia</i>	70
5.2.2	<i>Effect of Deflocculants on Densification and Hardness of Composites</i>	71
5.3	Discussion	75
5.3.1	<i>Role of CTAB in Dispersion of Alumina</i>	75
5.3.2	<i>Role of PABA in Dispersion of Alumina</i>	79
5.4	Conclusions	81
	References	82
6	Effect of Whisker Addition on Mechanical Properties of Composite	85
6.1	Experimental Procedures	86
6.2	Results and Discussion	87
6.2.1	<i>Whisker Concentration Effect on Hardness</i>	90
6.2.2	<i>Whisker Concentration Effect on Flexural Strength</i>	92
6.3	Conclusions	96
	References	97
7	Effect of Sintering Temperature on Morphology of Whisker and Properties of Composite	99
7.1	Experimental Procedures	99
7.2	Results and Discussion	101
7.2.1	<i>Microstructure Analysis</i>	101
7.2.2	<i>Effect of Sintering Temperature and Whisker Concentration on Density</i>	103
7.2.3	<i>Effect of Sintering Temperature on Whisker Morphology</i>	105
7.2.4	<i>Effect of Sintering Temperature and Whisker Concentration on Hardness</i>	107
7.3	Conclusions	111
	References	112
8	Low Temperature Tetragonal Phase Stability of TZ-3Y Composite Reinforced with Alumina Whiskers	114
8.1	Experimental Procedures	115
8.2	Results and Discussion	117
8.2.1	<i>Effect of Sintering Temperature on LTD</i>	119
8.3	Conclusions	126
	References	127
9	Effect of HAp Addition on Biocompatibility of the Composite	129
9.1	Experimental Procedure	130
9.1.1	<i>Preparation of AACH Whiskers</i>	130
9.1.2	<i>Preparation of HAp Nanoparticles</i>	130
9.1.3	<i>Formation of TZ-3Y+Al₂O₃+HAp Nanocomposites</i>	130
9.1.4	<i>Cell Adhesion</i>	132
9.2	Results and Discussion	132
9.2.1	<i>Surface Morphologies</i>	132
9.2.2	<i>Fracture Mechanism</i>	134
9.2.3	<i>Densification of Composite</i>	135
9.2.4	<i>Effect of Whisker Addition on Hardness and Flexural Strength of Composite</i>	137
9.2.5	<i>X-Ray Diffraction Analysis</i>	141
9.2.6	<i>Cell Adhesion Biocompatibility Test</i>	144
9.3	Conclusions	147
	References	148
10	Conclusions	151