

Contents

List of figures.....	viii
List of tables.....	xvii
Preface.....	xviii

Chapter 1: Introduction and literature review..... (1- 115)

1.1 Biomaterials	(1)
1.2 Hydroxyapatite (HA).....	(2)
1.3 HA nanocrystals.....	(3)
1.4 Synthesis methods.....	(5)
1.4.1 Synthesis of 1-D HA nanocrystals	(6)
1.4.1.1 HA nanorods.....	(6)
1.4.1.1.1 Role of experimental parameters	(12)
(i) Role of organic additives.....	(12)
(ii) Role of pH.....	(20)
(iii) Role of calcination temperature.....	(24)
(iv) Role of elemental doping.....	(24)
1.4.1.2 HA nanowires.....	(28)
1.4.1.2.1 The transformation of HA nanorods to nanowires.....	(32)
1.4.1.3 HA nanofibers.....	(34)
1.4.1.4 HA nanotubes.....	(39)
1.4.1.5 HA nanoneedles, nanobelts, nanowishkers and nanoribbons.....	(43)
1.4.2 Synthesis of 2-D HA nanocrystals	(47)
1.4.2.1 HA nanoplates.....	(47)
1.4.2.2 HA nanosheets.....	(52)

1.5 Biomedical applications of HA nanocrystals.....	(55)
1.5.1 Bone tissue engineering.....	(55)
1.5.1.1 Controlling parameters for mechanical, biodegradation and biological response of HA nanocrystals	(66)
1.5.1.1.1 Effect of content of HA nanocrystals	(66)
1.5.1.1.2 Influence of culture duration.....	(69)
1.5.1.1.3 Effect of morphology of HA nanocrystals.....	(71)
1.5.1.1.4 Effect of elemental doping.....	(72)
1.5.1.1.4 Effect of aspect ratio of HA nanocrystals.....	(72)
1.5.2 Antibacterial response of HA nanocrystals and its composites	(73)
1.5.3 Drug delivery.....	(75)
1.6 Motivation.....	(77)
1.7 Objectives.....	(79)
 Chapter 2: Experimental details.....	(116-131)
2.1 Synthesis of different shapes of HA nanocrystals.....	(116)
2.2 Structural, physical, and chemical characterizations	(117)
2.3 Hemolysis assay	(118)
2.4 Cellular response.....	(119)
2.4.1 Cell viability.....	(120)
2.4.2 Fluorescence imaging	(120)
2.4.3 Alkaline phosphatase (ALP) evaluation	(121)
2.5 Antibacterial activity.....	(121)
2.5.1 Quantitative assessment	(122)
2.5.1.1 MTT assay.....	(122)

2.5.2 Qualitative assessment	(122)
2.5.2.1 Colony-counting method.....	(122)
2.5.2.2 Live-dead assay	(123)
2.5.3 Reactive oxygen species (ROS) assay	(123)
2.5.3.1 Superoxide dismutase (SOD) assay	(124)
2.5.3.2 Catalase assay	(124)
2.5.3.3 Lowry protein assay	(125)
2.5.3.4 Lipid peroxidation (LPO) assay.....	(125)
2.6 Drug delivery.....	(126)
2.6.1 Drug loading and release experiments.....	(126)
2.6.2 Phase evaluation, morphological, and chemical characterizations	(126)
2.6.3 Cellular response	(127)
2.6.4 Hemolysis assay.....	(127)
2.6.5 Antibacterial response.....	(128)
 Chapter 3: HA nucleation and crystal growth.....	(132-153)
3.1 XRD analyses.....	(132)
3.2 FTIR analyses.....	(135)
3.3 Raman spectroscopic analyses.....	(137)
3.4 Nanomorphological analyses: crystal growth.....	(138)
3.5 TEM analyses.....	(145)
3.6 Summary.....	(147)
 Chapter 4: Cytocompatibility and osteogenic response	(154-175)
4.1 Particle size and zeta potential measurement.....	(154)

4.2 XPS analyses.....	(155)
4.3 Ion leaching response.....	(157)
4.4 Contact angle measurement	(159)
4.5 Hemocompatibility.....	(160)
4.6 Cellular response.....	(163)
4.6.1 Cell viability evaluation.....	(162)
4.6.2 Cell adhesion.....	(164)
4.6.3 Osteogenic differentiation.....	(165)
4.7 Discussion.....	(167)
 Chapter 5: Antibacterial efficacy	(176-202)
5.1 Antibacterial response.....	(176)
5.1.1 Quantitative assessment	(176)
5.1.1.1 Bacterial viability.....	(176)
5.1.2 Qualitative assessment.....	(179)
5.1.2.1 Colony-counting.....	(179)
5.1.2.2 Live-dead assay.....	(181)
5.1.3 ROS assessment.....	(182)
5.1.3.1 Superoxides estimation.....	(182)
5.1.3.2 Evaluation of H ₂ O ₂ dissociation.....	(184)
5.1.3.3 ROS-induced damaged proteins.....	(185)
5.1.3.4 MDA estimation.....	(187)
5.1.4 Mechanism for morphology-induced antibacterial response.....	(189)
5.2 Summary.....	(191)

Chapter 6: HA nanoplates as a novel antibiotic drug vehicle.....	(203-224)
6.1. Drug loading response: Role of morphology.....	(203)
6.1.1. FTIR and XRD: Drug loading evidence.....	(205)
6.1.2. SEM and TEM: Morphological changes.....	(206)
6.1.3. XPS analyses: Interaction between HA and DOX.....	(209)
6.2 <i>In vitro</i> drug release	(211)
6.3 Cytocompatibility.....	(214)
6.4 Hemocompatibility.....	(216)
6.5 Antibacterial activity.....	(216)
6.6 Summary.....	(220)
 Chapter 7: Conclusions and future perspectives.....	 (225-231)
Conclusions.....	(225)
Future perspectives.....	(228)
 List of Publications and Patent.....	 (230)