CHAPTER 2

Scope and Objectives
2.1 INTRODUCTION AND OBJECTIVES

Bionanocomposites have established themselves as a promising class of hybrid materials derived from natural synthetic biodegradable polymers and organic/inorganic fillers. In the last few years, the exploration on these bio-materials has received very important attention from researchers with expertise in diverse areas of nanotechnology, biomedical engineering and material science.

The nanotechnology field is one of the interesting areas for current research and development in all technical disciplines. The nanocomposites of inorganic materials in polymer matrices have attracted a great deal of attention because of their wide area of applications including biosensors. Different approaches have been developed for the synthesis of nanocomposites such as incorporation of premade nanoparticles into the polymer matrix. This can be achieved with the use of a common blending solvent or by reduction of metal salt dispersed in polymer matrix using an external reducing agent. The metallic and metal oxide nanoparticles have become an area of growing interest of fundamental studies and technological applications, due to their unique mechanical, chemical and magnetic properties. The metal nanoparticle embedded polymer film can show enhanced mechanical and biomedical properties.

Chitosan is non-toxic, biocompatible, biodegradable and polar biopolymer. Due to its biodegradability, biocompatibility and avirulence, Chitosan has been used in many biomedical applications. The properties of high mechanical strength, hydrophilicity, good adhesion and non-toxicity of chitosan offer it as food additive, anticoagulant and wound healing accelerator. Though chitosan has the ability to form films, the tensile properties of pristine chitosan film are poor (due to its crystallinity). Thus, the modification of chitosan has gained its importance for tailoring the desired mechanical properties. Since chitosan is alkaline in nature, by combining it (as graft copolymer or blend) with the biodegradable
polymers like polylactic acid, polyglycolic acid which generate acidic biproducts, the local toxicity at the implant site can be reduced\textsuperscript{12–14}.

Chitosan has been widely used in tissue engineering as a scaffold\textsuperscript{15}, orthopedic implants\textsuperscript{16} and in drug delivery applications\textsuperscript{17}. Generally, drug release kinetics of polymeric drug delivery systems is usually characterized by membrane permeability and diffusion coefficient, which are employed to describe the release behavior of the membrane reservoir system and the diffusion mechanism of the release system\textsuperscript{18}. Furthermore, both indexes in polymer-based materials are strongly dependent on crystallinity, plasticization and swelling behavior of the biopolymer drug delivery vehicle, which are also affected by the type and presence of the nanofillers\textsuperscript{19–21}. So, the secondary objective of the proposed work is to evaluate the effect of the nanofillers on the controlled drug release from the nanohybrids.

2.2 APPROACHES

2.2.1 Glycolic acid grafted chitosan and gold nanoparticles based nanocomposite

2.2.1.1 Grafting of chitosan with glycolic acid

2.2.1.2 Preparation of grafted chitosan and gold nanoparticles based nanocomposite films and porous scaffolds

2.2.1.3 Structural analysis by XRD, FTIR, UV, TEM, SEM, DMA, TST, TGA and AFM techniques.

2.2.1.4 Loading of cyclophosphamide drug and controlled release studies.

2.2.1.5 Biocompatibility studies by \textit{in-vitro} cell-culture testing.

2.2.2 Glycolic acid grafted chitosan and Au-Fe\textsubscript{3}O\textsubscript{4} hybrid nanoparticle based nanocomposite

2.2.2.1 Grafting of chitosan with glycolic acid
2.2.2 Preparation of grafted chitosan and Au-Fe$_3$O$_4$ hybrid nanoparticles based nanocomposite films and porous scaffolds

2.2.2.3 Structural analysis by XRD, FTIR, UV, TEM, SEM, PPMS, DMA, TST, TGA and AFM techniques.

2.2.2.4 Loading of cyclophosphamide drug and controlled release studies.

2.2.2.5 Biocompatibility studies by in-vitro cell-culture testing.

2.2.3 Glycolic acid grafted chitosan and Pt-Fe$_3$O$_4$ hybrid nanoparticle based nanocomposite

2.2.3.1 Grafting of chitosan with glycolic acid

2.2.3.2 Preparation of grafted chitosan and Pt-Fe$_3$O$_4$ hybrid nanoparticles based nanocomposite films and porous scaffolds

2.2.3.3 Structural analysis by XRD, FTIR, UV, TEM, SEM, PPMS, DMA, TST, TGA and AFM techniques.

2.2.3.4 Loading of cyclophosphamide drug and controlled release studies.

2.2.3.5 Biocompatibility studies by in-vitro cell-culture testing.

2.2.4 Glycolic acid grafted chitosan and Co$_3$O$_4$ hybrid nanoparticle based nanocomposite

2.2.4.1 Grafting of chitosan with glycolic acid

2.2.4.2 Preparation of grafted chitosan and Co$_3$O$_4$ hybrid nanoparticles based nanocomposite films and porous scaffolds

2.2.4.3 Structural analysis by XRD, FTIR, UV, TEM, XPS, SEM, PPMS, DMA, TST, TGA and AFM techniques.

2.2.4.4 Loading of cyclophosphamide drug and controlled release studies.

2.2.4.5 Biocompatibility studies by in-vitro cell-culture testing.
2.2.5 Glycolic acid grafted chitosan and Co₃O₄-Fe₃O₄ hybrid nanoparticle based nanocomposite

2.2.5.1 Grafting of chitosan with glycolic acid

2.2.5.2 Preparation of grafted chitosan and Co₃O₄ -Fe₃O₄ hybrid nanoparticles based nanocomposite films and porous scaffolds

2.2.5.3 Structural analysis by XRD, FTIR, UV, TEM, SEM, PPMS, XPS, DMA, TST, TGA and AFM techniques.

2.2.5.4 Loading of cyclophosphamide drug and controlled release studies.

2.2.5.5 Biocompatibility studies by in-vitro cell-culture testing.

2.3 REFERENCES