CHAPTER I

INTRODUCTION

1.1 Statement of Problem

The performance of biomedical devices and biomaterials depends strongly upon the surface properties of materials since it is the surface of materials that first comes into contact with biological surroundings. Several approaches have been applied for modification of material's surface to suit specific biomedical applications. Layer-by-layer (LBL) adsorption of oppositely charged polyelectrolytes is an efficient method to fabricate biocompatible polyion complex multilayers film on substrate. This method has been developed over the past several years as a powerful and versatile method for surface modification of materials. The process, in its simplest form, involves sequentially dipping a charged substrate into dilute aqueous solutions of oppositely charged polyelectrolytes and allowing the polymer to adsorb and reverse the charge of the substrate surface. The thickness of multilayer film can be varied as a function of adsorption variables as well as the number of deposition. Most importantly, the surface properties of supported film are determined by the outermost layer that is last deposited.

Chitosan is a partially deacetylated form of chitin, a natural substance found abundantly in the exoskeletons of insects, shells of crustaceans, and fungal cell walls. Because of its favorable physicochemical and biological properties such as biocompatible, non-toxic, antibacterial, chitosan is considered as an attractive material that can be potentially used in many biomedical-related applications. As a cationic polyelectrolyte, chitosan is capable of forming electrostatic interactions with anionic polyelectrolytes. Several researches have been reported about the formation of polyion complex multilayer film between chitosan and a number of anionic polyelectrolytes. However, none has been reported on charged derivatives of chitosan whose biological properties are significantly different from ones of

chitosan. Sulfonated chitosan, a negatively charged derivative of chitosan, is antithrombogenic whereas quaternary ammonium chitosan, a positively charged derivative possesses superior antimicrobial activity.

In this study, we focus our attention on assembling biocompatible polyion complex thin film from chitosan and its charged derivatives : SFC and HTACC. The first part of this research involves the synthesis and characterization of those two charged derivatives of chitosan. Formation of polyion complex multilayer films from three pairs of oppositely charged polyelectrolytes is explored: chitosan (CHI) and poly(sodium styrene sulfonate) (PSS), poly(allylamine hydrochloride) (PAH) and *N*-sulfofurfuryl chitosan (SFC), *N*-[(2-hydroxyl-3-trimethylammonium)propyl]chitosan chloride (HTACC) and polyacrylic acid (PAA). Contact angle analysis, Attenuated Total Reflectance-Fourier Transform Spectroscopy (ATR-FTIR) and Quartz Crystal Microbalance (QCM) are used as tools to follow the assembly process. And lastly, biological responses of all polyion complex multilayer films are tested by protein adsorption studies. We hypothesize that alternate response can be achieved as long as each layer is thick enough and overall biological response depends on the outermost layer. The consequence of this study should provide fundamental information that can lead to the further development of chitosan and its derivatives for biomedical applications.

1.2 Objectives

1. To prepare polyion complex thin film containing chitosan and chitosan derivatives using layer-by-layer assembly by controlling adsorption variables and the number of deposition.

2. To study protein adsorption of polyion complex thin film containing chitosan and chitosan derivatives.

1.3 Scope of Investigation

The stepwise investigation was carried out as follows.

1. To survey for literature related to research work
2. To synthesize positively and negatively charged derivatives of chitosan
3. To investigate the effects of adsorption variables on the individual and overall thicknesses of assembled film
4. To prepare multilayer films from chitosan and chitosan derivatives
5. To characterize multilayer films
6. To determine biological response of multilayer films against proteins.