CHAPTER I

INTRODUCTION

1.1 Statement of Problem

The control of surface property is a key significance to several commercially important technologies ranging from biotechnology to advanced microelectronics. One of the novel surface modification methods is to use polymer brushes. Conventionally, polymer brushes are prepared by adsorption of block copolymers where one block is strongly adsorbed to the surface with the other block forming the brush layer. The noncovalent nature of this grafting strategy is a weakness, however, since the desorption of the brush can subsequently occur. In addition, the demanding block copolymer synthesis limits the choice of functional groups for the block copolymer structure. Another method is to use the "grafting to" technique, in which preformed polymer chains in solution are tethered to the surface. This method does not allow high-density brushes to be formed due to the exclusion of chains as the graft density grows. Nonetheless, the molecular weight distribution can be easily controlled since polymer fractions with narrow molecular weight can be used. The other approach, in principle more versatile, is the "grafting form" or the "surface-initiated polymerization" technique, in which polymerization is initiated from initiators coupled covalently to the surface. One should be able to grow very high-density polymer brushes on a substrate using the latter method, if proper conditions are employed.

The use of controlled/living polymerization for surface-initiated polymerization should be optimal because such methods afford good control over the molecular weight, molecular weight distribution, and structure of the resulting polymer. Several mechanisms have been used to grow polymer chains from a surface, including radical, anionic, cationic, ring-opening, ring-opening metathesis. There is growing interest in atom transfer radical polymerization (ATRP) since it

was discovered in 1995. The living characteristic and the compatibility with a variety of functional monomer render ATRP an attractive method for surface-initiated polymerization in producing well-defined polymer brushes. The process allows a better control of target molecular weight and molecular weight distribution. The success of ATRP in synthesizing hydrophilic polymers provides an additional advantage over the traditional living ionic polymerization.

As inspired by the biomembrane-like structure, a methacrylate monomer bearing a polar phospholipid group, 2-methacryloyloxyethyl phosphorylcholine (MPC) was developed. The excellent blood compatibility of the MPC-containing material is proven to originate from the capability to induce self-assembly of natural phospholipids. Since hydrophilic MPC homopolymer possesses inferior mechanical properties, MPC is generally used in the form of copolymers, polymer coating and grafting. The issue related the formation of grafted PMPC with well-defined structure, molecular weight and graft density is a subject of considerable interest and yet to be explored. Here we propose a way to generate blood-compatible polymer brushes by surface-initiated polymerization of MPC using ATRP. Blood compatibility is addressed in terms of plasma protein adsorption and platelet adhesion. We anticipate that MPC polymer brushes with well-defined molecular weight and graft density would allow a better control of the blood compatibility at microscopic or nanoscopic scale of the material's surface.

1.2 Objectives

1. To synthesize poly(2-methacryloyloxyethyl phosphorylcholine) brushes by surface-initiated atom transfer radical polymerization.

2. To study the effect of the thickness of PMPC brushes on blood compatibility.

1.3 Scope of Investigation

The stepwise investigation was carried out as follows.

1. Literature survey for related research work.
2. To study the kinetic of atom transfer radical polymerization of MPC in solution.
3. To prepare the initiator-containing substrate.
4. To synthesize PMPC brushes by surface-initiated polymerization from the initiator-containing substrate.
5. To investigate the effect of the thickness of PMPC brushes on the blood compatibility.