The development of modified functionalized membranes will result in improved membrane adsorbers for protein and antibody separation. In addition, it will lead to discoveries in sequential polymerization to generate customized structures, sequencing of non-peptide polymers, and design of synthetic affinity ligands. Functionalization of microfiltration membranes with polymeric grafts is an excellent method to obtain high concentration of active sites for adsorption. Sequential cationic polymerization is an effective method to functionalize and add adsorption sites in the pores of the membrane. Styrene and two types of substituted styrene monomers, 4-ethoxystyrene (ES) and chloromethylstyrene (CMS) will be used to form an analog of a phenylalanine/tyrosine dipeptide structure, and to introduce spacer units. The dipeptide structure is shown in literature to be critical for selective adsorption of antibody IgG.

This thesis focuses on two aspects. The first is synthesis and characterization of homopolymer and blocks copolymer grafts through sequential cationic polymerization of styrene and substituted styrene monomers CMS and ES. The second aspect focuses on understanding polymer growth by changing parameters such as initiator contact time and monomer feed concentration. Sulfonic acid initiator sites are introduced into the membrane by mild sulfonation with 0.5 N H₂SO₄. This is followed by cycling through each type of monomer solution of substituted styrenes. Successful introduction of homopolymer and block copolymer grafts have been confirmed by material balances on the monomer/toluene permeate solutions. Analytical techniques used for characterization of polymer grafts include UV-Visible spectroscopy, gas chromatography and atomic absorption. Functionalized membrane prepared by this method have as many as 437 repeat units per chain. The highest IEC of the functionalized membrane was calculated to be 4.9 meq/g, indicating high dynamic and equilibrium binding capacity. The functionalized membrane also shows a steep decrease in membrane permeability compared to the raw membrane indicating the presence of polymeric chains in the membrane flow path. Additionally the polymer growth rate changes and slows down above critical initiator surface density. These evidence indicated that the work will have broader impact for high throughput production of monoclonal antibodies for new cancer therapies.