Porous polypropylene membranes with grafted cation-exchange polymer layers for protein separation

Abstract

Affinity chromatography technique permits the purification of proteins based on their surface charge, special domain structures or even their specific biological function [1]. Traditionally, packed beds are used, but this technology has several limitations. The high pressure drop across a packed bed, channelling due to uneven packing and, especially, the severe influence of slow intra-particle diffusion onto separation efficiency are the major problems. The latter effect causes also significant speed limitations for gradient elution, or complete buffer exchange and equilibration. All these problems make the scale-up of packed bed affinity chromatography or solid phase extraction difficult. Macroporous membranes had been proposed more than a decade ago in order to overcome the limitations of particle beds [1,2]. The transport of solutes through the membrane pores can take place by convection, the pressure drops for high flow rates are much lower, and the scale up is rather easy. In the meantime, first commercial membrane adsorbers are on the market. However, the interplay of membrane pore size and distribution, affinity binding and flow rates is still not understood in all details, and hence the potential of porous affinity membrane adsorbers cannot be fully exploited yet. Hydrophilic membranes have good characteristic of low nonspecific adsorption of proteins but have poor thermal stability and are susceptible to chemical agents. In contrast, hydrophobic membranes have good thermal stability and chemical resistance but high non-specific protein adsorption. Therefore, a modification of hydrophobic polymer membranes that introduces hydrophilic segments on the surface is an ideal method for combining the advantages of hydrophilic and hydrophobic membranes