Continuous Affinity Protein Separation with Dynamic Electrochemical Membranes

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Introduction
The downstream protein separation and purification cost can be as high as 85% of the total cost of the recombinant therapeutics protein production[1]. Immobilized metal ion affinity chromatography (IMAC) for affinity protein separation is most widely used but suffers from limitations of expense, slow complex binding, purge, desorption cycles, long intra-particle diffusion time and column regeneration[2]. Affinity membrane chromatography with convection flow through the functionalized pores improve mass transport to binding site but has low binding capacity area (thin membranes) thus requiring numerous binding/purge/release cycles and suffers from indiscriminate flow induced fouling[3]. Electroosmosis through inorganic nanoporous membranes has been used for non-affinity protein separation but still suffers from poor selectivity/fouling of sized-based exclusion for proteins of the same charge. A) Needed is a transformative idea in membranes that selectively bind proteins to pore entrance and pumps them through a membrane in a continuous manner.

Objectives
1. Producing multi-electrode membranes with protein receptor chemistry at 10nm diameter pores entrance.
2. Demonstrating continuous affinity protein separation using repeated binding and release/pumping electrophoretic voltage pulses.

AAO Membrane Electrode Pore Entrance Size Control

Electrochemical Functionalization

Demonstration of Membrane Functionalization

Gate Keeper Blocking of Functionalized Membrane

Direct Electrophoretic Pumping Process

Pulse Electrophoretic Pumping Process

References


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