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PH-RESPONSIVE CONTROLLED RELEASE CHARACTERISTICS OF SOLUTES WITH DIFFERENT MOLECULAR WEIGHTS DIFFUSING ACROSS MEMBRANES OF CA-ALGINATE/PROTAMINE/SILICA HYBRID CAPSULES

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ABSTRACT

Ca-alginate/protamine/silica (APSi) hybrid capsule membranes with pH-responsive controlled release characteristics are successfully prepared by combining co-extrusion minifludics, adsorption and biosilicification under different pH conditions from 3 to 7. The micro-structures of the prepared capsule membranes are characterized by optical photography, CLSM and SEM. The pH-responsive permeability of APSi hybrid capsule membranes is controlled by the electrostatic interactions between Ca-alginate networks and protamine molecules. Four kinds of solute molecules with different molecular weights including methylene blue, VB_{12}, 4 kDa and 10 kDa FITC-dextran molecules, are selected as solute molecules to comparatively study the diffusional permeability characteristics of solutes across APSi hybrid capsule membranes.

The results show that, for the solutes with suitable molecule sizes such as VB_{12} and 4 kDa FITC-dextran, the diffusional permeabilities across the capsule membranes at pH 4 are lower than those at pH 5; however, for the solutes with too small molecule size such as methylene blue or too large molecule size such as 10 kDa FITC-dextran, the diffusional permeabilities across the capsule membranes at pH 4 are very close to those at pH 5. The results in this study provide valuable guidance for fabrication and application of APSi capsule membranes in the various fields including controlled release of drugs and immobilization of enzymes and so on.

KEYWORDS

ph-Responsive Membranes, Capsule Membranes, Hybrid Membranes, Diffusional Permeability, Ca-Alginate Capsules

PM-19

EXPLICIT EXPRESSIONS FOR THE MINIMUM EFFICIENCY AND MOST PENETRATING PARTICLE SIZE OF NUCLEPORE FILTERS

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ABSTRACT

Nuclepore filters are capillary pore membrane filters with an array of microscopic cylindrical holes of uniform diameters. Their structure is suitable for particle collection and ensuing offline analyses, therefore they are being widely used for exposure assessment of engineered nanoparticles, ambient $PM_{2.5}$, virus, bacteria, asbestos, etc., as well as in powder manufacturing industries. However, there exists a particle size range in which all the filtration capture mechanisms are not effective. This size is the most penetrating particle size (MPPS), which corresponds to the minimum efficiency (ME) of the filter. Both MPPS and ME are important parameters for a user to select an adequate Nuclepore filter and preferred operating conditions. For rapid estimation of the MPPS and ME, we derived their explicit expressions by simplifying the formulas for the impaction, diffusion and interception deposition and differentiating the combined efficiency with respect to the particle size. The comparison between the experimental data and the prediction from the explicit expressions shows the explicit expressions can provide MPPS for a wide range of filter properties (pore radius, porosity and length) and filtration conditions (particle density, face velocity and temperature). The ME can also be estimated satisfactorily when a simplified term of filter surface diffusion deposition is further considered. By the explicit expressions of MPPS and ME, a quick screening for selecting a Nuclepore filter with the proper properties and suitable filtration conditions can be easily achieved. From the theoretical point of view, the explicit expressions facilitate better understanding of the effects of filter properties and conditions on the filtration characteristics.

KEYWORDS

Exposure Assessment, Nuclepore Filter, Most Penetrating Particle Size, Minimum Efficiency, Explicit Expression