Materials & Chemicals

Porous Silicon Nanomembranes for the Rapid Separation of Macromolecules by Size and Shape

WiSys: T180038WO01

Inventors: Gokul Gopalakrishnan, Mark Levenstein

WiSys is seeking a strategic partner skilled in the development and manufacturing of membranes used for the separation and/or detection of biologic molecules in solution. There is additional interest in a partner with the expertise to identify and test novel applications for these nanomembranes.

Overview

The separation or isolation of proteins from a heterogeneous mixture is a common practice in scientific experimentation and the manufacturing of biologic reagents. Commercially available kits and current laboratory methods to achieve separation are based upon the average size of proteins in solution. This is a limitation when multiple macromolecules of similar calculated mass to a target are present. However, a nanomembrane with openings designed to filter specific structural shapes would allow, for instance, the separation of proteins beyond just their size and molecular weight. In addition, such nanomembranes have utility for the separation of other molecular structures possessing differences in shape as a result of genetic mutation. This includes some cancerous or pathogenic variants such as the pathogen responsible for chronic wasting disease (CWD), a prion protein that causes fatal neurological disease in deer, elk, and moose. While normal and pathogenic prions have identical masses, they differ in their structural shapes. The current methods for detecting these prions and CWD are limited by the proteins' similarities in size often yielding false positives or resulting in delays in the testing process. Nanomembranes able to distinguish cancer markers or pathogenic species from the healthy or benign forms would provide another tool in the arsenal of advanced healthcare, personalized medicine, disease detection, and treatment.

The Invention

Researchers at the University of Wisconsin-Platteville have developed a unique nanomembrane for the separation of biomolecules based on their three-dimensional geometries. These "macromolecular sieves" are produced from laser-etched silicon nanomembranes. The pores in these membranes have openings in the sub-micron range but are designed to significantly reduce the flow impedance of the filtered solution. This design feature allows for faster filtration time when compared with traditional membranes. Nanomembranes with square and rectangular geometries have been produced. Desirable characteristics of the square opening membrane include a high open area of 45% and low standard deviation in opening size (less than 5%). Additionally, the fabricated membranes have been tested with vacuum pumps and show no signs of damage after repeated filtrations with 15 psi of applied pressure differential. Currently, reducing opening size below 100 nm and introducing openings of varying geometries is under development. Further efforts are also underway to decrease the manufacture time and increase the overall scalability of the membrane patterning process.

Applications

- Separation of macromolecules from a heterogeneous solution by structural shape;
- Designed for low flow impedance during filtration;
- Robust membranes capable of filtration in conjunction with a vacuum or syringe pump;
- Nanomembranes with high open areas (up to 45%) and low pore size standard deviation (less than 5%)

Key Benefits

- Platform technology with the ability to be developed for and used in various applications;
- Ability to generate customized pore patterns for specific needs of clients;
- Expandable for higher-scale targets (e.g. virion particles, bacteria, protists);
- Ability to align and orient high-aspect-ratio macromolecular structures (CNTs, DNA, 3D printing of aligned microfibers for oriented tissue growth and other applications).

Stage of Development

Porous silicon nanomembranes have been fabricated with openings in the sub-micron range with square and rectangular geometries. The structural design of the pores alleviates restrictions resulting from flow impedance. Reducing opening size below 100 nm and introducing openings of varying geometries is under development. Further efforts are also underway to decrease the manufacture time and increase the overall scalability of the membrane patterning process. . Additionally, the filtration of specific microbes (E. Coli & Mycoplasma) is being investigated.

Tech Fields

- Materials & Chemicals : Biochemicals & biomaterials
- Medical Devices : Diagnostics & monitoring tools

For current licensing status, please contact Jennifer Souter at jennifer@wisys.org or (608) 316-4131