

# **Nanoporous Membrane Market - Global Industry Size, Share, Trends, Opportunity, and Forecast, 2018-2028 Segmented By Material Type (Organic, Inorganic, Hybrid), By Application (Water Treatment, Fuel Cells, Biomedical, Food Processing, Others), By Region and Competition**

<https://marketpublishers.com/r/N49990C9A911EN.html>

Date: August 2023

Pages: 115

Price: US\$ 4,900.00 (Single User License)

ID: N49990C9A911EN

## **Abstracts**

Global Nanoporous Membrane market is expected to grow at an impressive rate through 2028 due to the increasing demand for clean water. In 2022, water withdrawals per capita in the United States amount to 1,207 cubic meters per inhabitant.

Nanoporous membranes are thin films or sheets with tiny pores, typically less than 100 nanometers in size. These membranes have emerged as promising materials for various applications, including water filtration, gas separation, drug delivery, and sensing. Their distinctive properties, such as high porosity, high surface area, and tunable pore size, make them appealing for a varied range of scientific and technological applications. The fabrication of nanoporous membranes is based on various techniques, such as template synthesis, self-assembly, and block copolymer lithography. In the template synthesis method, a porous material, such as anodized aluminum oxide or silica, is used as a template to create a nanoporous membrane. The template is then removed, leaving behind the nanoporous structure. In the self-assembly method, a surfactant or block copolymer is used to create a micelle or a vesicle structure, which is then cross-linked to form a nanoporous membrane. Block copolymer lithography involves the use of a block copolymer, which self-assembles into a periodic pattern, which is then transferred onto a substrate to create a nanoporous membrane.

One of the key applications of nanoporous membranes is in water filtration. Nanoporous membranes can remove impurities, such as bacteria, viruses, and salts, from water. The pore size of the membrane can be controlled to selectively remove certain impurities while allowing other molecules to pass through. This makes nanoporous membranes useful in desalination, wastewater treatment, and water purification.

The increasing demand for clean water for industrial and domestic use, coupled with the growing need for wastewater treatment and desalination, is driving the growth of the water treatment segment. Nanoporous membranes can remove impurities, such as bacteria, viruses, and salts, from water. The pore size of the membrane can be controlled to selectively remove certain impurities while allowing other molecules to pass through, making it ideal for water filtration applications.

The increasing demand for targeted drug delivery and the need for controlled release of drugs are driving the growth of this segment. Nanoporous membranes can be utilized to load drugs, which can then be released at a controlled rate. This has potential applications in targeted drug delivery, where the drug can be released at a specific location in the body.

Drug delivery is an area where nanoporous membranes are being explored. The high surface area and porosity of the membrane can be utilized to load drugs, which can then be released at a controlled rate. This has potential applications in targeted drug delivery, where the drug can be released at a specific location in the body. In sensing applications, nanoporous membranes can be used to detect various analytes, such as gases, liquids, and biological molecules. The nanoporous structure can enhance the sensitivity of the sensor, making it possible to detect low concentrations of the analyte.

### Efficient Energy Usage and Increasing Demand for Clean Water are Driving Market Growth

Access to clean water is a growing concern worldwide, and nanoporous membranes are a promising solution for water filtration and purification. These membranes can remove impurities, such as bacteria, viruses, and salts, from water. The ability to selectively remove certain impurities while allowing other molecules to pass through makes nanoporous membranes ideal for water filtration applications.

Nanoporous membranes are also used in energy-related applications, such as gas separation and energy storage. The membranes can also be used as electrodes in

energy storage devices such as batteries and supercapacitors. The ability to control the pore size and surface chemistry of nanoporous membranes makes them highly tunable for energy-related applications. The growing need for energy-efficient processes and the increasing demand for alternative energy sources are driving the growth of the global nanoporous membranes market.

Advancements in nanotechnology are driving the growth of the nanoporous membranes market. The development of new materials and fabrication techniques, coupled with increasing knowledge of the behavior of molecules at the nanoscale, has led to significant advancements in nanoporous membranes. Researchers are exploring new applications and optimizing the performance of nanoporous membranes, leading to the development of more efficient and cost-effective membranes.

### Targeted Drug Delivery is Driving Market Growth

The pore size of the membrane can be controlled to allow certain molecules to pass through while retaining others, making it possible to selectively release drugs at specific locations in the body. This has the potential to improve drug efficacy and reduce side effects. The increasing demand for targeted drug delivery and the need for controlled release of drugs are driving the growth of the nanoporous membranes market in healthcare and pharmaceuticals.

### Major Challenges Faced by Nanoporous Membrane Market

One of the significant challenges in the global nanoporous membrane market is the fabrication and scalability of these membranes. Nanoporous membranes require precise control over pore size, shape, and distribution, making their fabrication a complex and expensive process. Additionally, scaling up production to meet commercial demand is challenging, as the cost and complexity of fabrication increase with larger membrane sizes. There is a need for more cost-effective and scalable fabrication techniques to make nanoporous membranes more accessible and practical for widespread use.

Nanoporous membranes are often exposed to harsh conditions, such as high pressure, temperature, and corrosive environments. Therefore, their stability and durability are crucial for their long-term performance. Unfortunately, many nanoporous membranes suffer from poor stability and durability, leading to membrane fouling, degradation, and reduced lifespan. Researchers need to develop new materials and fabrication techniques that improve membrane stability and durability, making them suitable for

long-term use in harsh conditions.

Nanoporous membranes are designed to selectively allow certain molecules to pass through while retaining others. However, achieving the desired selectivity and permeability can be challenging due to the complex interactions between the membrane surface and the molecules being filtered. Additionally, membrane fouling can reduce selectivity and permeability over time, leading to decreased membrane performance. There is a need for improved understanding of the fundamental principles of selectivity and permeability to design more efficient and effective nanoporous membranes.

### Recent Trends and Developments

In 2020, researchers at the University of California, Berkeley, developed a new 3D printing technique to fabricate nanoporous membranes. The technique uses a 3D printer to create a scaffold structure, which is then coated with a layer of polymer that is selectively removed to create nanopores. The 3D printing technique enables the fabrication of complex membrane geometries with precise pore size control.

Mixed matrix membranes are hybrid membranes consisting of a nanoporous matrix and a polymer or metal filler. In recent years, researchers have developed new mixed matrix membranes with improved selectivity and permeability. For example, in 2021, researchers at the University of Twente, the Netherlands, developed a mixed matrix membrane consisting of graphene oxide and zeolite. The membrane demonstrated high permeability and selectivity for gas separation applications.

Self-healing membranes are a new class of membranes that can repair themselves after damage. In 2019, researchers at the University of Maryland developed a self-healing nanoporous membrane using a coating of chitosan, a natural polymer found in crustacean shells. The membrane demonstrated improved stability and durability, making it ideal for use in harsh environments.

In recent years, researchers have explored the use of nanoporous membranes for energy storage applications. For example, in 2019, researchers at MIT developed a nanoporous membrane electrode for flow batteries. The membrane demonstrated improved efficiency and stability, making it a promising candidate for large-scale energy storage.

Water purification is one of the most promising applications of nanoporous membranes. In 2021, researchers at Purdue University developed a new membrane for water

purification. The membrane consisted of a layer of graphene oxide and a layer of nanoporous metal-organic framework. The membrane demonstrated high selectivity and permeability for water purification applications.

## Market Segmentation

Global Nanoporous Membrane Market is segmented based on Material Type, Application, Region, and Competitive Landscape. Based on the Material Type, the market is categorized into Organic, Inorganic, and Hybrid. Based on Application, the market is segmented into Water Treatment, Fuel Cells, Biomedical, Food Processing, and Others. Based on region, the market is divided into North America, Europe, Asia Pacific, South America, Middle East & Africa.

## Market Players

BASF SE, Alfa Laval AB, Applied Membranes Inc., AXEON Water Technologies Inc., DowDuPont Inc., Hunan Keensen Technology Co. Ltd., inopor GmbH, Koch Membrane Systems Inc., Pure-Pro Water Corporation, SiMPore Inc. are some of the key players in the Global Nanoporous Membrane Market.

## Report Scope:

In this report, Global Nanoporous Membrane market has been segmented into the following categories, in addition to the industry trends, which have also been detailed below:

### Nanoporous Membrane Market, By Material Type:

Organic

Inorganic

Hybrid

### Nanoporous Membrane Market, By Application:

Water Treatment

Fuel Cells

Biomedical

Food Processing

Others

### Nanoporous Membrane Market, By Region:

North America

United States

Mexico

Canada

Europe

France

Germany

United Kingdom

Spain

Italy

Asia-Pacific

China

India

South Korea

Japan

Australia

South America

Brazil

Argentina

Colombia

Middle East & Africa

South Africa

Saudi Arabia

UAE

Competitive landscape

Company Profiles: Detailed analysis of the major companies present in Global Nanoporous Membrane market.

Available Customizations:

With the given market data, TechSci Research offers customizations according to a company's specific needs. The following customization options are available for the report:

Company Information

Detailed analysis and profiling of additional market players (up to five).

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