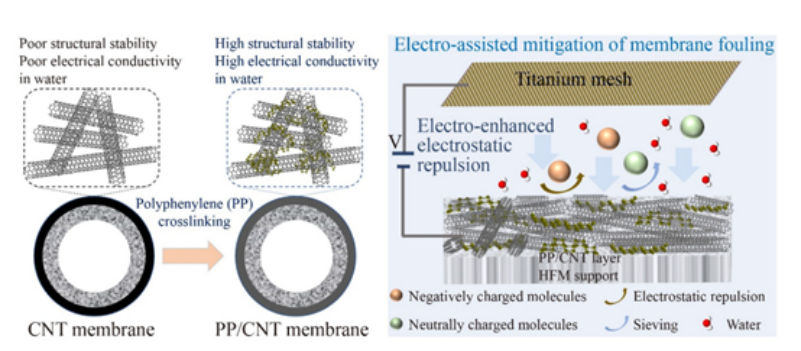
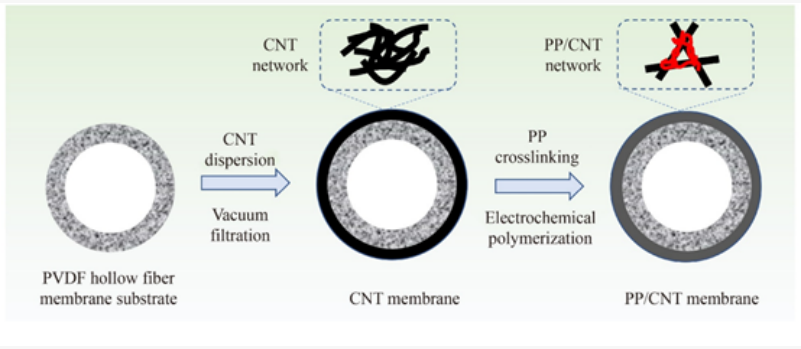
Breakthrough in Water Treatment – The PP/CNT Composite Membrane

CHINA, November 17, 2023 /EINPresswire.com/ -- Membrane fouling, a significant impediment in water treatment, reduces the efficiency and lifespan of filtration systems. To combat this, the new PP/CNT membrane, created through electropolymerizing biphenyl on a CNT hollow fiber membrane, exhibits remarkable structural stability and electrical conductivity. This design significantly outperforms existing solutions, displaying 3.4 and 5.0 times higher conductivity than pure CNT and poly(vinyl alcohol)/CNT (PVA/CNT) membranes, respectively.



Graphic abstract.



Scheme for the fabrication of PP/CNT membrane.

In a new study published on 15 August 2023, in the journal Frontiers of Environmental Science & Engineering, researchers from Dalian University of Technologyhave have introduced a groundbreaking polyphenylene/carbon nanotube (PP/CNT) composite membrane. This cutting-edge development in membrane technology promises a revolutionary approach to water treatment and wastewater management. The PP/CNT membrane stands out for its remarkable electrical conductivity and superior antifouling properties, effectively tackling the persistent issue of membrane fouling in water purification processes.

The study conducted an in-depth analysis of the properties and performance of the PP/CNT membrane, utilizing sophisticated techniques like SEM imaging and comprehensive chemical analysis. These meticulous examinations confirmed the membrane's impeccable structure and successful creation, showcasing a flawless configuration with high stability under diverse conditions. In terms of electrical conductivity, the membrane excelled, particularly in wet environments, where it demonstrated conductivity levels significantly surpassing those of its counterparts. An essential aspect of the membrane's design, its hydrophilicity, remained intact

post-PP crosslinking, a vital attribute contributing to its antifouling efficiency.

A standout feature of the PP/CNT membrane is its exceptional antifouling performance when subjected to electro-assistance, especially under a negative voltage. This novel method markedly diminishes flux reduction and effectively counters fouling, a fact underscored in tests against a variety of pollutants such as humic acid, sodium alginate, and E. coli. The application of a negative voltage notably enhances the electrostatic repulsion between the negatively charged pollutants and the membrane surface. Conversely, a positive voltage boosts the removal efficiency through mechanisms like electro-adsorption and electrooxidation. Most impressively, the PP/CNT membrane operating at -2.0 V demonstrated extraordinary stability and reusability. It achieved nearly complete flux recovery after backwashing and exhibited significantly lower irreversible fouling compared to conventional commercial membranes.

Highlights
 A conductive and stable polyphenylene/CNT membrane was fabricated.
 The conductivity of the membrane was 3.4 times higher than that of the CNT membrane.
 Structural stability of the membrane is superior to that of the CNT membrane.
 Electro-assistance can effectively enhance membrane fouling mitigation.

The implications of this development for water treatment applications are profound. The PP/CNT composite membrane opens new avenues for more effective, sustainable, and reliable water purification processes, addressing one of the most critical challenges in environmental management and public health.

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