Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2024, 16(01):01-02

Commentary

ISSN: 0975-7384
CODEN (USA): JCPRC5

Effect of Polydopamine on Promoting Anti-Fouling and Multifunctional Properties of Membranes

Wenyan He*

Department of Geology and Environment, Xi'an University of Science and Technology, Xi'an, China

Received: *08-Jun-2023, Manuscript No. JOCPR-23-101887;* ***Editor assigned****:12-Jun-2023, PreQC No. JOCPR-23-101887 (PQ);* ***Reviewed:*** *26-Jun-2023, QC No. JOCPR-23-101887;* ***Revised:*** *27-Dec-2023, Manuscript No. JOCPR-23-101887 (R);* ***Published:*** *03-Jan-2024, DOI:10.37532/0975-7384.2024.16(01).070.*

DESCRIPTION

Based on the global energy and resource crisis and strategic requirements of the Chinese government regarding the "double carbon" policy, which respectively aims to achieve a peak in carbon dioxide emissions before 2030 and carbon neutrality before 2060, recovering valuable resources (water resources, nutrients including nitrogen and phosphorus) and energy (organic carbon source) from the vast amounts of urban sewage has become a vital measure for realizing carbon emission reduction and energy self-sufficiency at sewage treatment plants. Membrane based pre-concentration coupled with other biochemical processes provides technical support for the efficient recovery of low-concentration carbon sources in municipal sewage. However, single-function (separation, filtration, or catalysis alone) and membrane fouling become the main technical issues limiting large scale applications of membrane materials.

Membrane modification with inorganic nanoparticles has emerged as one of the approaches to address the single-function problems. While how to load the inorganic nanoparticles efficiently without compromising the integrity and stability of the film is another thorny question. In addition, except for the water quality and operational issues, the most fundamental measure for membrane fouling is to improve the anti-adhesion and chemical resistance of the membrane material, thus increasing the membrane flux, separation efficiency, and lifetime.

One of the primary reasons for the unstable loading of inorganic nanoparticles on the membrane surfaces is the lack of interaction between them. To address this issue, an intermediate layer is introduced to modify the membrane surface. In doing so, it is crucial to consider the interfacial compatibility of the introduced interlayer with both the membrane and inorganic nanoparticles. Poly-dopamine exhibits self-polymerizing and substrate-independent coating capabilities and offers an extremely versatile platform for inorganic nanoparticle binding. Furthermore, the extraordinary surface functional groups of poly-dopamine promote the possibility of hydrogen bonding to anchored nanoparticles. Poly-dopamine can be coated by post-treatment of the membranes or by blending dopamine into the precursor solution, and then loaded by triggering self-polymerization.

High hydrophobicity and roughness, as well as the opposite charge of the contaminant to the membrane surface, exacerbate membrane fouling. In general, surface modification with desired polymers or inorganic materials could minimize this problem. For example, introducing hydrophilic functional groups (hydroxyl (-OH) and amine ($-NH_2$) groups in the molecular of poly-dopamine) can form a hydrogen bond with water molecules. The formed hydration layers on the surface of the membrane slowed down the growth rate of the hydrophobic contaminants. In addition, loading appropriate nanoparticles not only enhances the shear stress of the water flow and generates local turbulence, thus enhancing permeability, but also alters the charge on the membrane surface and thus mitigates the membrane contamination via repulsive forces. Moreover, obtaining randomly oriented 3D nano channels by tuning the preparation parameters is an alternative approach to reduce the possibility of membrane plugging.

The development of versatile composite membrane materials with high performance is a future research trend considering their versatile, durable, and environmentally friendly properties. The safety of monomers used in the preparation of composite membrane materials should also be taken into account to avoid the decomposition of toxic monomers during long term use. Monomers with good biological descriptions are preferred. From an economic point of view, the popularity of composite materials cannot be separated from price reductions. Multifunctional composite membrane materials provide technical support for the comprehensive recovery of resources in sewage.