Fabrication of a superhydrophilic PVDF based membrane using a facile prefabricated TiO_2 nanoparticles surface

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Abstract

The hydrophilicity of PVDF membrane is playing an enormously important role in its widespread water treatment fields considering the excellent intrinsic properties of PVDF raw materials. Rather than the conventional surface modification or hybridization, herein, we report a novel approach to prepare highly hydrophilic PVDF UF membrane by creating a prefabricated super-hydrophilic surface of inorganic TiO_2 nanoparticles (NPs). The resultant membrane [prepared by prefabrication surface adhesion of TiO_2 NPs on PVDF-PEG-TiO_2 hybrid membrane (SaT-PPT)] has a uniform distribution of TiO_2 NPs not only on the membrane surface but also within membrane matrix, this will maximize the super-hydrophilic feature throughout the membrane: from inner porous structures to outer surfaces, and will avoid "dead-corner" to block fast water pass through. The performances of SaT-PPT membrane as compared with the control membranes (PVDF-PEG, and PVDF-PEG with TiO_2 anchored only at surface) were investigated in terms of humic acid (HA) rejection, flux and flux decline in lab-made cross flow UF experiments with and without UV irradiation. It indicated that SaT-PPT membrane exhibited the highest hydrophilicity and flux, lowest flux decline and total resistance, but still with the highest HA rejection rate. Moreover, it was found that the presence of TiO2 NPs on the membrane surface increased the surface energy of the membrane (i.e. 51 mJ m^{-2}) that increased the wettability potential of the membrane. In addition, SaT-PPT membrane showed the highest flux recovery after simple physical cleaning to extend the longer life span of membrane. It is reasonable to believe that our developed SaT-PPT membranes will provide insightful engineering practices to benefit the broad water treatment applications.

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