Visible-light Responsive Multifunctional Membrane for the Separation of Oil-Water Mixtures and Simultaneous Water Decontamination Supported by Theoretical Models

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Effective remediation of oily wastewater includes the oil-water separation and the decontamination of organic pollutants. Although membranes with a characteristic selective wettability of water over oil have a high oil-water separation efficiency in a gravity driven operation (>98.1%), they are incapable of degrading organic pollutants. Furthermore, they cannot withstand harsh operating conditions due to their fragile coating, which limit their large-scale application. In this work, a facile thermal treatment of a stainless-steel membrane at 800 and 1000 degree was successfully applied to fabricate a novel mechanically robust two-faced membrane, fit-tingly called a multifunctional membrane due to its dual functionality. The feed side of the multifunctional membrane is super hydrophilic-superoleophobic, which allows the water phase to pass through it while retaining the oil phase with a high percentage of rejection for all types of oil-water mixtures (>99.9%). The permeate side of the multifunctional membrane is a photocatalytic active surface (iron oxide), whose primary function is to photo-catalytically decontaminate the organic pollutants present in the water-rich permeate under visible light irradiation with a high degradation value. Two theoretical models were proposed to study the photocatalytic activity of the membrane as a function of relevant sys-tem parameters, which confirmed that the models were in agreement with the experimental results. This approach may potentially enable large-scale applications in oily wastewater treatment.

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