Influence of TiO2 nanostructures on anti-adhesion and photoinduced bactericidal properties of thin film composite membranes

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Resumen

This work investigates the influence of TiO2 nanostructures on the anti-adhesion and photoinduced bactericidal properties of thin film composite (TFC) membranes. TiO2 nanostructures with different morphologies, nanoparticle size, and crystalline phase contents were incorporated within the membrane structure during the interfacial polymerization process. The membranes were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDX), atomic force microscopy (AFM), and contact angle measurements. Bacterial anti-adhesion tests were performed using Escherichia coli. Bacteria suspensions were incubated in the presence of the modified membranes under three different conditions (dark, UV, and visible light) with the aim to induce photoactivation of the TiO2 nanostructures. The anti-adhesion properties of the membranes were confirmed by fluorescence microscopy using a live/dead bacterial viability kit. XRD, SEM, and EDX analyses confirmed that the TiO2 nanostructures were incorporated into the membrane. This incorporation resulted in TFC membranes exhibiting excellent bacterial anti-adhesion properties, as well as marked bactericidal activity. The anti-adhesion effect can be attributed to the physicochemical properties of the modified membrane surface (mainly hydrophilicity) and the bactericidal effect on the membrane surface was attributed to the photoactivation of TiO2 nanostructures upon irradiation, mainly by UV light. The influence of the morphology and the dispersion capacities of the TiO2 nanostructures on anti-adhesion and photoinduced bactericidal properties of TFC membranes were evidenced. The incorporation of a mixture of nanoparticles and nanorods into the TFC membrane reached higher hydrophilicity, lower roughness and uniform dispersion on the surface membrane improving the anti-adhesion capability and the bacterial degradation performance upon irradiation.

Palabras clave

KeyWords Plus:REVERSE-OSMOSIS MEMBRANES; NANOFILTRATION MEMBRANES; WATER-TREATMENT; TFC MEMBRANE; RO MEMBRANE; NANOPARTICLES; PERFORMANCE; SUBSTRATE; SURFACE

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