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Water Treatment Using Nanotechnology Enhanced Membranes

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Membrane filtration has seen an increased demand in recent years especially in water treatment and desalination due to population growth, stringent drinking water and wastewater disposal legislations, and emergence of non-conventional wastewater such as produced water from oil and gas fields. Membranes are used in pre- and post-water treatment as well as in water desalination. In addition, membranes are used in a wide range of industrial, medical and environmental applications. Polymeric membranes are still prevailing in such applications because of their high permeability, low cost, mechanical strength, ease of fabrication, and thermal and chemical stability. In addition, polymeric membranes are diverse in their fabrication processes, membranes' properties and applications making them the best choice for a wide range of natural or wastewater treatment. However, membrane fouling is a major obstacle reducing the efficiency of membrane water treatment. Fouling is the accumulation of matter at the surface of the membrane. It causes rapid increase in differential pressure, reduction in water production, lower water quality and shorter membrane lifetime.

There is an emerging interest towards the modification of membranes using semiconductor metal oxides nanomaterials such as zinc oxide, titanium dioxide, iron (III) oxide (α-Fe_2O_3) and zinc sulfide. These nanomaterials enhance the physical and chemical properties of the membranes to ensure high membrane performance. Specific chemical species in the nanomaterials functionalizes the membranes by interacting with the polymeric membrane chemical groups. Controlled synthesis of functionalized membranes is essential to fabricate membranes with high permeability and salt rejection as well as better resistance to fouling and scaling at reasonable costs.

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