**Single oxide and Bimetallic oxide membrane for photo-electrocatalytic degradation of persistent organic pollutants in wastewater**

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A major problem that is worldwide prominent is the presence of Persistent organic pollutants (POPs) in surface and ground water. Conventional physico-chemical techniques are unable to completely remove quickly and efficiently such POPs and new remediation techniques are therefore required. Photo-electro catalytic membrane reactors represent an emerging, smart solution that can combine molecular sieving and simultaneous catalytic degradation of such contaminants. Herein, porous stainless steel substrates with pore size of 2-5 µm have been functionalized to fabricate single and bimetallic oxide membrane by layer by layer deposition of TiO2 and ZnO. Membrane fabrication is achieved via an advanced fabrication route named Atomic layer deposition (ALD) that ensures uniform and conformal deposition of catalytic material giving a robust membrane that ensures minimal flaking of deposited layers. The morphology of deposited layer can be controlled by varying the deposition cycles from 50 to 400 leading to enhanced catalytic performance. The structural properties upon a series of deposition cycles of prepared membranes are also assessed to investigate morphology, microstructure, nano-crystallinity, thickness of coatings, roughness and other optical properties. The photocatalytic efficiency of the fabricated membranes after annealing at 550℃ is tested on a reference Methylene Blue (MB) dye solution. TiO2 and ZnO films presenting homogenous morphology and a thickness of 24 nm and 47 nm respectively for 400 deposition cycles led to the highest catalytic efficiency. The catalytic activity is also correlated to the crystallite size of metal oxides for 400 deposition cycles which is in in the order of 4-5 nm. A maximum dye rejection of 65% is observed by TiO2 membranes and 76%by ZnO membranes for 400 deposition cycle under UV light irradiation (320-390 nm). Bimetallic oxide membranes of TiO2 and ZnO of same deposition cycle have thickness of 35 nm and showed MB dye rejection upto 55%. The prepared membranes are also used to study the photo-electrocatalytic degradation of model POPs such as Atrazine and Chlorpyrifos for which membrane is irradiated with UV light (365 nm) along with voltage supply (0.1-0.7 V) that endows it with photo-electrocatalytic properties. The filtration experiments are conducted in cross-flow system, using model POPs, under UV light and voltage supply. The influence of several parameters, such as feed pressure, feed concentration and flow rate, on the pollutant degradation efficiency and membranes permeability are investigated and analyzed. Furthermore, the novel hybrid process is compared with the standard Microfiltration technique in regard with energy consumption and removal efficiency of these POPs. For standard MF processes, there is reported value of 40-50 % COD removal in 8 h in permeates of Chlorpyrifos solution. High Performance Liquid Chromatography (HPLC) is used for monitoring the degradation kinetics of POP along with analyzing the by-products formed during photo-electro catalytic degradation process of POPs.

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