

Oleophilic to oleophobic wettability switching of isoporous through-hole membranes by surface structure control for low-voltage electrowetting-based oil-water separation

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Wettability control is a critical element in oil-water mixture separation, which is usually implemented by chemical treatment steps such as coating or chemical deposition. The treated surfaces may degrade both chemically and physically upon repeated use and exposure to harsh conditions. In this work, we have demonstrated wettability switching, from oleophilic to oleophobic, of soft-lithographically fabricated isoporous through-hole membranes by structure control only, while maintaining their intrinsic hydrophobicity. Applied voltage converts the water wettability from hydrophobic to hydrophilic by electrowetting phenomenon, without affecting oleophobicity; this hydrophilic/oleophobic combination has enabled successful oil-water separation. Soft lithographic fabrication of isoporous membranes has enabled easy variation of pore size, ranging from tens of microns down to sub-micron scale in diameter, so that those membranes can be applied for both stratified and emulsified oil-water mixture separation. Based on these properties, stratified and emulsified (both oil-in-water and water-in-oil) oil-water mixtures could be separated in high efficiency (>99%) and relatively high flux.