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Synthesis of Superhydrophobic Alumina Membrane: Effects of Sol-gel Coating, Steam Impingement and Water Treatment

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ABSTRACT

Ceramic membranes possess natural hydrophilicity thus tending to absorb water droplets. The absorption of water molecules on membrane surface reduces their application in filtration, membrane distillation, osmotic evaporation and membrane gas absorption. Fluoroalkylsilane (FAS) grafting allows the conversion of hydrophilic ceramic membranes into superhydrophobic thin layer, but it usually introduces a great increment of mass transfer resistance. In this study, superhydrophobic alumina membranes were synthesized by dip coating alumina support into sol-gel and grafted with the fluoroalkylsilane (FAS) named (heptadecafluoro-1,1,2,2-tetra hydrodecyl) triethoxysilane. Steam impingement and water treatment acted as additional steps to generate surface roughness on sol-gel and most importantly to reduce mass transfer resistance. Superhydrophobic alumina membrane with high water contact angle (158.4 ^{o}) and low resistance (139.5±24.9 Gm^{-1}) was successfully formed when the alumina membrane was dip coated into sol-gel for 7 s, treated with steam impingement for 1 min and immersed in hot water at 100 ^{o}C. However, the mass transfer resistance was greatly induced to 535.6±23.5 Gm^{-1} when the dip coating time was increased to 60 s. Long dip coating time contributes more on the blockage of porous structure rather than creates a thin film on the top of membrane surface. Reducing the pore size and porosity significantly due to increase of coating molecules deposited on the membrane. Steam impingement for 1 min promoted the formation of cones and valleys on the

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