

Title: Surface modification of SiO₂ nanoparticles and its impact on the properties of PES-based hollow fiber membrane

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Abstract: In this work, polyethersulfone (PES) hollow fiber membranes incorporated with modified silicon dioxide (SiO₂) nanoparticles were prepared and characterized for a water treatment process. Prior to doping preparation, commercial SiO₂ nanoparticles were first modified using a sodium dodecyl sulfate (SDS) solution to minimize their agglomeration in the dope solution. The surface-modified nanoparticles were analysed by TEM, BET and zeta potential to determine the particle size, surface area and surface charge, respectively. The effect of modified SiO₂ loadings ranging from zero to 4 wt% on the properties of PES-based membranes was examined with respect to thermal stability, hydrophilicity, mechanical strength, pure water flux and protein rejection. The results showed that the modified nanoparticles have reduced agglomeration and greater negative surface charge in comparison to the unmodified nanoparticles. SEM-EDX and FTIR analyses confirmed the presence of modified SiO₂ in the PES membrane matrix. It is also found that the thermal stability and hydrophilicity of the composite membranes were improved upon the addition of modified SiO₂. The pure water flux and protein rejection of the composite membranes were significantly higher than the control PES membrane. At optimum nanoparticle loading (2 wt%), the composite membrane demonstrated 87.23 L m⁻² h⁻¹ water flux and 93.6% protein rejection in comparison to 44.2 L m⁻² h⁻¹ and 80.8% shown by the control PES membrane. The results suggested that the modified SiO₂ nanoparticles have great potential to improve membrane water flux without compromising its rejection capability.