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A simple secondary growth method for the preparation of silicalite-1 membrane on a tubular silica support via gel-free steam-assisted conversion

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Abstract

Silicalite-1 membranes with high pervaporation (PV) performance were prepared on a seeded tubular silica support using modified steam-assisted conversion (SAC) under gel-free conditions, called the gel-free SAC method, for the first time. The seeded support was first dipped in a TPAOH aqueous solution and dried. Subsequently, the TPAOH-coated silicalite-1 seed layer was converted into a silicalite-1 membrane layer, followed by heating in an autoclave with a small amount of water at the bottom of the autoclave. In this method, silica support was not only used as the support but also as the silica source to grow the zeolite seed layer into a continuous and dense zeolite membrane layer. In other words, no additional supply of silica source such as synthesis gel to grow the seed layer was required. The silicalite-1 membrane prepared in this study had a separation layer with a thickness of approximately 7 μm and exhibited high PV performance with a separation factor of 66 and high flux of 4.47 kg m^{-2} h^{-1} for 10 wt% ethanol/water mixtures at 323 K. This membrane preparation method is quite simple and uses minimum necessary reagents. Therefore, it is economical and suitable for the preparation of membranes on an industrial scale.