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Atomic-layer-deposition-enabled thin-film composite membranes of polyimide supported on nanoporous anodized alumina

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Abstract

Polyimide is deposited on the surface of nanoporous anodized alumina by atomic layer deposition (ALD) using pyromellitic dianhydride and ethylenediamine as the two precursors. Such ALD reactions directly produce polyimide rather than the intermediate polyamic acid. The precursor exposure duration plays an important role in determining the growth rate of PI and consequently the reduction of effective pore sizes. ALD with short precursor exposure confines the deposition predominantly around the pore openings of the alumina substrates, producing an asymmetric structure in the form of thin-film composites. This structure efficiently reduces the pore sizes of alumina, and as a result the retention of the membrane is significantly improved. A moderate cycle number of 50 remarkably increases the rejection of the membrane from nearly none to 82% at an acceptable expense of a