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Abstract

Microporous silica membranes with high permselectivity are fabricated by atmospheric-pressure plasma-enhanced chemical vapor deposition (AP-PECVD) using hexamethyldisiloxane as the precursor in plasma working gases of pure argon, and mixture of argon with oxygen or nitrogen. A silica membrane grown using plasma composed of a mixture of argon and nitrogen displays highly efficient gas separation, with selectivities for He/N_2 and He/SF_6 of 196 and 820, respectively, and He permeance of 1.1×10^{-7} mol m^{-2} s^{-1} Pa^{-1} at 50 °C. Characterization of the membranes by FTIR and X-ray photoelectron spectroscopies reveals a relatively high concentration of carbon remains in the membrane grown using a mixture of argon and nitrogen. Annealing at elevated temperature after plasma deposition improves the permselectivity of the membranes. After annealing at 300 °C, the permeance of He at 50 °C increased to 4.0×10^{-7} mol m^{-2} s^{-1} Pa^{-1} with no marked decrease of selectivity (He/N_2 = 98, He/SF_6 = 770). The annealed membrane also exhibits remarkable permselectivity for CO_2, showing selectivities for CO_2/N_2 and CO_2/CH_4 of 46 and 166, respectively, with CO_2 permeance of 1.9×10^{-7} mol m^{-2} s^{-1} Pa^{-1} at 50 °C. AP-