Neha Bighane, Insights in Analytical Electrochemistry, 3:2
DOI: 10.21767/2470-9867-C1-002

Novel silica and silica-titania membranes for high temperature gas separations

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Concern over depleting supplies of fossil fuels (coal, oil and natural gas) and increasing global warming has driven tremendous interest worldwide in the development of alternate clean fuels. Hydrogen gas is a suitable candidate for a clean, abundant and efficient source of energy. Hydrogen is primarily produced from the steam reforming of natural gas coupled with the water gas shift reaction. Selective removal of H_2 from syngas mixture in the presence of steam at 200-350°C can increase the efficiency of the water gas shift reaction. It has been estimated that an overall energy saving of 43% in the water gas shift reaction can be achieved with the presence of a H_2/CO_2 membrane unit. A gas separation membrane is a robust material that enables selective permeation of one gas from a mixture based on partial pressure driving force. Novel silica and silica-titania membranes were developed from the controlled oxidative thermolysis of crosslinked polydimethylsiloxane precursors. The PDMS precursor film is prepared by humidity induced condensation cure reaction of PDMS resin with an alkoxy crosslinker. The rubbery PDMS films are heated to 377°C in an oxygen atmosphere in a tubular furnace and this results in the formation of silica membrane films. The developed silica membranes are microporous amorphous silica, have 1.4% water adsorption and can withstand up to 377°C in an oxidizing environment. They exhibit high hydrogen permeability and moderate H_+/CO_2 selectivity. Silica-titania membranes have been fabricated from controlled oxidative thermolysis of Ti-crosslinked PDMS by heating to 407°C. The developed silica-titania membranes are microporous amorphous silica-titania, have 0.85% water adsorption and can withstand up to 407°C in an oxidizing environment. At 80°C at 30 psia, silica membranes have selectivity of H_2/CO_2= 2 and H_2/N_2=20. At 35°C at 55 psia, silica-titania membranes have molecular sieving selectivity of H_2/CO_2=2.33, H_2/N_2=H_2/CH_4=64 and O_2/N_2=4.97. Material characterization studies on silica and silica-titania membranes include TGA, FTIR, XPS, SEM, EDS, TEM, BET and adsorption measurements.

Biography

Neha Bighane done Master of Science in Chemical Engineering, from Georgia Institute of Technology, Atlanta, USA, in Spring 2012. She was 8 years graduate research assistant, 2007-2015, ChBE, Georgia Tech, USA. She was junior research fellow, for PhD degree, in Indian Institute of Chemical Technology (Hyderabad, India) in collaboration with Royal Melbourne Institute of Technology (Melbourne, Australia). She published 2 Paper in Journal of Membrane Science, she attended 5 in national and international conferences She was Selected as a Global Scholar by PreScouters Inc., in February 2015 and awarded certificate of merit in social science by CBSE, India in 2001.

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