A comprehensive review and perception of carbon molecular sieve membranes for hydrogen production and purification

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Abstract:
Hydrogen (H2) as a high-quality and clean energy carrier has attracted renewed and everincreasing attention around the world in recent years, mainly due to developments in fuel cells and environmental pressures including climate change issues. In thermochemical processes for H2 production from fossil fuels, separation and purification is a critical technology. Where water–gas shift reaction is involved for converting the carbon monoxide to H2, membrane reactors show great promises for shifting the equilibrium. Membranes are also important to the subsequent purification of H2. For H2 production and purification, there are generally two classes of membranes both being inorganic: dense phase metal and metal alloys, and porous ceramic membranes. Porous ceramic membranes are normally prepared by sol–gel or hydrothermal methods, and have high stability and durability in high temperature, harsh impurity and hydrothermal environments. In particular, microporous membranes show promises in water gas shift reaction at higher temperatures. In this article, we review the recent advances in both dense phase metal and porous ceramic membranes, and compare their separation properties and performance in membrane reactor systems. The preparation, characterization and permeation of the various membranes will be presented and discussed. We also aim to examine the critical issues in these membranes with respect to the technical and economic advantages and disadvantages. Discussions will also be made on the relevance and importance of membrane technology to the new generation of zero-emission power technologies.

Keywords: Membranes; Dense Metal Membranes; Porous Membranes; Hydrogen Production; Hydrogen Purification

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