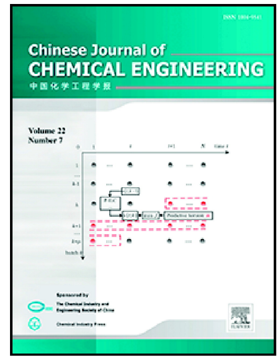

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PII: S1004-9541(17)30954-0
DOI: doi:10.1016/j.cjche.2017.11.007
Reference: CJCHE 969

To appear in:

Received date: 25 July 2017
Revised date: 1 November 2017
Accepted date: 10 November 2017

Please cite this article as: Muhammad Sarfraz, M. Ba-Shammakh , Water-stable ZIF-300/ Ultrason® mixed-matrix membranes for selective CO2 capture from humid post combustion flue gas. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Cjche(2017), doi:10.1016/j.cjche.2017.11.007

Separation Science and Engineering

Water-stable ZIF-300/Ultrason® mixed-matrix membranes for selective CO_2 capture from humid post combustion flue gas

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Abstract
Water stable mixed-matrix membranes (MMMs) were developed to help control the global warming by capturing and sequestrating carbon dioxide (CO_2) from post combustion flue gas originated from burning of fossil fuels. MMMs of different compositions were prepared by doping glassy polymer Ultrason® S 6010 (US) with nanocrystals of zeolitic imidazolate frameworks (ZIF-300) in varying degrees. Solution-casting technique was used to fabricate various MMMs to optimize their CO_2 capturing performance from both dry and wet gases. The prepared composite membranes indicated enhanced filler-polymer interfacial adhesion, consistent distribution of nanofiller, and thermally established matrix configuration. CO_2 permeability of the membranes was enhanced as demonstrated by gas sorption and permeation experiments performed under both dry and wet conditions. As compared to neat Ultrason® membrane, CO_2 permeability of the composite membrane doped with 40 wt % ZIF-300 nanocrystals was increased by four times without disturbing CO_2/N_2 ideal selectivity. In contrast to majority of previously reported membranes, key features of the fabricated MMMs include their structural stability under humid conditions coupled with better and unaffected gas separation performance.

Key Words
Hydrophobic MMMs, ZIF-300, gas permeation, CO_2 capture, permselectivity

1. Introduction

Global warming issues can be resolved to a great extent by controlling CO_2 emissions by its separation from post combustion flue gases, thus protecting the world environment [1]. CO_2 capture or sequestration from a carbon-enriched gas mixture is one of the most cost-effectively feasible strategies to control carbon releases [2]. Amongst other typical carbon capture operations, gas separation process using polymer-based mixed-matrix membranes has gained significant importance due to its low energy requirement, high efficiency, easiness of scale up, simple design, uncomplicated function, economical operating costs and capital and environmental kindliness [3].

The key parameters of a superior quality gas separation membrane include improved permselectivity and separation factor, good mechanical strength, improved chemical and thermal stability, and good operational stability [4]. Due to its inherent structural constraints (chain mobility and inter-chain spacing), a glassy polymer membrane being highly permeable is generally less selective [5]; it requires considerable improvements for practical applications. A number of glassy polymers (such as poly(vinyl acetate), polydimethylsiloxane, polyimide, poly-