Gas Permeation Properties and Characterization of Polymer Based Carbon Membrane

N. Sazali\textsuperscript{1,*}, W.N.W. Salleh\textsuperscript{2,\dagger}, Zawawi Harun\textsuperscript{1,**} and A.F. Ismail\textsuperscript{2,\dagger}

\textsuperscript{1}Advanced Materials and Manufacturing Centre (AMMC) Department of Materials and Design Engineering, Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor Darul Takzim, Malaysia.

\textsuperscript{2}Advanced Membrane Technology Research Centre (AMTEC), Faculty of Petroleum and Renewable Energy Engineering (FPERE), Universiti Teknologi Malaysia, 81310 Skudai, Johor Darul Takzim, Malaysia.

\textsuperscript{*}Melye.jandi@yahoo.com, \textsuperscript{\dagger}hayati@petroleum.utm.my, \textsuperscript{**}zawawi@utm.edu.my, \textsuperscript{3}afzali@utm.my

Keywords: Polymeric precursor, heat treatment process, Permeation, carbonization, carbon membrane, gas separation.

Abstract. Membrane gas separation is a forthcoming technology that advertised a great commercial potential in diverse industrial applications. Consequently, membrane-based natural gas processing has been among the fastest growing segments of the economic growth. The turbostratic structure of carbon membranes has been affirmed to accommodate with good separation selectivity for permanent gases. With that, the most auspicious technique acquired is by controlling the carbonization temperature during the carbon membrane fabrication. In this study, polymer-based carbon tubular membranes have been fabricated and characterized in terms of its structural morphology and gas permeation properties. Polyimide (Matrimid 5218) was used as a precursor for carbon tubular membrane preparation to produce high-quality carbon membrane via carbonization process. The polymer solution was coated on TiO\textsubscript{2}–ZrO\textsubscript{2} tubular tubes (Tami) by using dip-coating method. The polymer tubular membrane was then carbonized under Nitrogen atmosphere at 600, 750, and 850 °C. The structural morphology of the resultant carbon membranes was analyzed by means of scanning electron microscope (SEM). Pure gas permeation tests were performed using CO\textsubscript{2} and N\textsubscript{2} gases at 8 bars and room temperature. Based on the results, the highest CO\textsubscript{2}/N\textsubscript{2} selectivity of 79.53 was obtained for carbon membrane prepared at 850 °C.

Introduction

In the past recent years, many efforts have been made to develop effective ways to separate the impurities in natural gases. Consequently, natural gas must designate cleaned to raise its fuel heating cost, decrease transport expenses, pipeline erosion besides atmospheric contamination [1, 2]. High permeation flux and high selectivity are essential requirements for a successful membrane [3]. Several methods assumed towards development of polyimide membranes involve tailoring molecular structure to achieve an innovative materials plus altering current polyimide materials through cross-linking method, grafting side groups on polymer backbone also heat treatment process [4], Various structures of polyimide have remained established in literatures thru changing the monomer structures [5, 6].