SYNTHESIS AND CHARACTERIZATION OF NOVEL CARDO-CONTAINING COPOLYIMIDE MEMBRANES FOR GAS SEPARATION AND EFFECT OF BULKY SITE IN THE POLYMER BACKBONE

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A significant issue in environmental science is the climate change caused by global warming. The increase in the global temperature could lead to a range of negative effects that include rising sea levels, changes in ecosystems, loss of biodiversity, and reduction in crop yields. Currently, it is generally accepted that greenhouse gases such as carbon dioxide, methane, nitrous oxide, and fluorinated gases from fossil fuels and industrial wastes are primarily responsible for global warming. One method of slowing the rate of global warming is to reduce carbon dioxide emission into the air and to substitute fossil fuel for alternative energy sources. There are many methods of reducing greenhouse gas emissions, including improvements of energy efficiency, use of non-fossil fuel power sources, improved soil management, and the geological sequestration of carbon dioxide from significant greenhouse gas producing point sources. However, the most feasible and practical method at this moment is to capture the greenhouse gases from the fossil fuel combustion using amine absorption, physical adsorption, and membranes, etc. Membrane technology has been used for more than 50 years, and gas separation using membranes is used in several industrial processes such as the production of nitrogen from air, the separation of CO2 and H2O from natural gas, the purification of H2, and the recovery of vapors from vent gases, because it has various advantages such as low capital investment, ease of operation, and low energy consumption. To overcome the disadvantage of polyimide based materials in manufacturing and processing, researchers have developed various methods such as the introduction of flexible monomers, or chemical and thermal post-modification. One method to improve the properties of the membrane is the post-fabrication and thermal process, i.e. the thermally rearranged (TR) PBO membranes that exhibit excellent separation properties and superior thermal and chemical properties compared with commercialized engineering plastics. TR polymer membranes can be obtained from soluble polyimide containing functional groups such as –OH and –SH. The microcavity structure and distribution of soluble polyimide membranes are evolved during thermal treatment. In this study, we focus on the polyimide syntheses using both strategies of the introduction of bulky monomers and post-thermal treatments, yielding . synthesized 2,2-bis(3,4-dicarboxyphenyl) hexafluoropropane dianhydride (6FDA)-based copolyimide and hydroxyl monomer via polycondensation. In order to improve the gas separation properties and processability, we used highly CO2 permeable and selective monomers in the synthesis, and then evaluated the effect of the mole ratio monomers of the polymer on the gas separation performance. Finally, the copolyimide membrane was converted to a PBO structure via a thermal treatment in order to increase the rigidity and free volume of the polymer backbone. The degree of thermal conversion was controlled through varying the composition of the copolyimide. Then, the performances of the TR membranes were evaluated regarding their change in chemical structure, mechanical and thermal stability, and gas separation properties.