Abstract

Polymer membrane-based gas separation has experienced a substantial growth and become an important research topic during past decades as energy efficient and environmentally friendly separation processes over the conventional industrial methods. However, the general trade-off between permeability and selectivity associated with the polymeric membranes has initiated extensive research works around the world to develop the polymer membrane with high permeability and selectivity by proper molecular designing. In these scenario aromatic polyamides (PAs) which exhibited high gas selectivity with moderate permeability for different gas pair along with a number of outstanding properties such as good film forming ability, high thermal stability and high mechanical properties comes as a suitable membrane material. However, PAs are generally difficult to fabricate into fibers and films because of their insoluble nature in most organic solvents. The goal of this work was to develop the soluble new PAs suitable for gas separation applications with higher separation efficiency.

To achieve the set of goals, the gas transport properties of the four series of PAs prepared from four new diamines, 1,1-bis-[4'-{2"-triflurомethyl 4"-(4"'-aminophenyl)phenoxy}phenyl]cyclohexane (CBA), 1-adamantylmethyl[3,5-bis-{2'-trifluoromethyl-4'-(4"-aminophenyl)phenoxy}]benzoate (ABBA), 4-(1'-adamantanemethoxy)-4',4"-diaminotriphenylamine (ATBA) and 4-(2',4',6'-tri-*tert*-butylphenoxy)-4',4"-diaminotriphenylamine (BTBA) with five different commercially available aromatic diacids like TBIA, HFA, TA, IA and NA; towards four different gases CH_4, N_2, O_2 and CO_2 at 35 °C and an upstream pressure of 3.5 bar were investigated. The PAs were thoroughly characterized and were soluble in various organic solvents. The combination of thermal and mechanical properties of these PAs made them appropriate candidates for gas separation application. The highest permeability (P_{CO2} = 119.0 and P_{O2} = 29.0 Barrer) was observed for PA XVI, containing tri-*tert*-butylphenol substituted triphenylamine (TPA). Whereas, the highest ideal permselectivity values for CO_2/CH_4 (64.29) and O_2/N_2 (11.67) gas pairs were observed for the PA XIV (containing adamantane substituted TPA) and PA V (cyclohexylidene containing fluorinated diamine) respectively. The PAs showed excellent gas separation efficiency for O_2/N_2 gas pair and some of them surpassed the 2008 Robeson upper bound. An attempt has been made to draw a structure-property correlationship between the chemical structures of these PAs and their gas transport properties.

Keywords: *Polyamides, Bulky pendant groups, Triphenylamine, Solubility, Gas permeability, Ideal permselectivity.*