Abstract

Gas separation by selective permeation through polymer membranes is one of the fastest growing branches of separation technology. Naturally strong interest exists in the area of preparation of new membrane with higher separation efficiency. It has been observed that polyimides are the most attracted as the basic materials for gas separation membranes as they show high gas selectivity for different gas pair along with a number of outstanding properties such as high thermal and thermo-oxidative stability, good film forming ability, high mechanical properties and chemical stability. However, aromatic polyimides are generally difficult to fabricate into fibers and films because of their high melting or softening temperatures and insoluble nature in most organic solvents.

The goal of this research was to develop processable new aromatic poly(ether imide)s (PEIs), preparation of polyhedral oligomeric silsesquioxane (POSS) containing PEI mixed matrix membranes and a systematic investigation of gas transport properties of these membranes towards four different gases (CH_4, N_2, O_2 and CO_2) at three different temperatures (35, 45 and 55 ^oC). In this regard indan and fluorene containing two different series of PEIs were prepared based on two newly prepared fluorinated diamine monomers namely 3-(4'-amino-3-trifluoromethyl-biphenyl-4-yloxy-phenyl)-5-(4'-amino-3-trifluoro methyl-biphenyl-4-yloxy)-1,1,3-trimehylindane (BPI) and 4,4'-bis-((2'-trifluoromethyl-4'-(4''-aminophenyl) phenoxy)-9-fluorenylidene (FBP) with five different commercially available aromatic dianhydrides like PMDA, BTDA, 6FDA, ODPA, and BPADA. The polymers were thoroughly characterized by different instrumental techniques. All the PEIs were soluble in various organic solvents. High thermal stability along with high mechanical properties of these polymers made them suitable candidates for gas separation application. The highest permeability for CO_2 (57.45 Barrer) and O_2 (14.98 Barrer) was exhibited by BPI-6FDA whereas the highest ideal permselectivity values for CO_2/CH_4 (39.62) and O_2/N_2 (6.57) gas pairs have been found for FBP-6FDA and FBP-BTDA respectively. An attempt has been taken to draw a structure-property correlationship between the chemical structures of these polymers and their gas transport properties. Two series of POSS containing mixed matrix membranes were prepared, one with fixed POSS loading and another with different POSS loading and characterized thoroughly. A systematic investigation of gas transport properties were done to evaluate the effect of incorporation of POSS in the PEI membranes, with increase in POSS loading the permeability coefficient of all gases increases with a reduction in permselectivity.

Keywords: *Indan, Fluorene, Fluorinated poly(ether imide), Solubility, poly(ether imide)-POSS mixed matrix membrane, Gas permeability, Ideal permselectivity.*