Abstract

Membrane based gas separation is now successfully competing over highly sophisticated techniques like cryogenics, adsorption and absorption. Till now, many polymers have been considered as potential membrane materials but actually few of them found real application in industrial scale. Gas separation membranes should have sufficiently good mechanical and film-forming properties with a good chemical and thermal stability under the conditions of the separation process. Naturally strong interest exists in the area of preparation of new robust membranes having higher permeability and higher permselectivity values.

The principal goal of this research was to develop new solution-processable aromatic poly(ether amide)s (PAs) and polyamide-POSS nanocomposite membranes (MMMs) and an systematic investigation of their gas transport properties towards four different gases (CH_4, N_2, O_2 and CO_2) at 35 ^oC and 3.5 bar. In this regard five series of PAs were synthesized on reaction with five new fluorinated bis(ether amine)s namely 1,4-bis-[{2$^{'}$-trifluromethyl 4$^{'}$-(4$^{''}$-aminophenyl)phenoxy)]phenyl (HA), 4,4-bis-[2$^{'}$-trifluromethyl 4$^{'}$-(4$^{''}$-aminophenyl)phenoxy]biphenyl (BPA), 1,4-bis-[{2$^{'}$-trifluromethyl 4$^{'}$-(4$^{''}$-aminophenyl)phenoxy}]2,5-di-tert-butylbenzene (TBHA), 2',7'-bis-[2''-trifluoromethyl 4''-(4'''aminophenyl)phenoxy]-spiro[fluorene-9,9'-xanthene] (SFXA) and 9,9-bis-[3-phenyl-4-{2'-trifluoromethyl 4'-(4''-aminophenyl) phenoxy}phenyl]fluorene **(**BPPFA) with structurally different aromatic diacids by phosphorylation polycondensation. Polyamide-tethered polyhedral oligosilsesquioxane (POSS) nanocomposites (PAMIPs) were synthesized by Michael addition reaction between maleimide-containing fluorinated new copolyamides (PAMIs) with fixed loading of amino-functionalized POSS (POSS-NH_2) nanofiller. All these processable PAs, PAMIs and PAMIPs have been well characterized by different instrumental techniques. Transparent and flexible polymeric membranes were prepared from these PAs, PAMIs and PAMIPs from their DMAc solution. In terms of gas transport properties, these membranes are very attractive because they support the mechanical stresses imposed in the permeation cells for their good combination of thermal and mechanical properties. PA prepared from TBHA (diamine) and 5-tert-butyl-isophthalic acid (diacid) exhibited highest gas permeability for CO_2 (173 Barrer) and O_2 (44 Barrer). PA synthesized from BPPFA (diamine) and terephthalic acid (diacid) showed highest ideal permselectivity values for CO_2/CH_4 (88.37) gas pair; whereas PA prepared from BPPFA (diamine) and 5-tert-butyl-isophthalic acid (diacid) exhibited highest permselectivity values for O_2/N_2 (10.84) gas pair. An attempt has been taken to draw a structure-property correlationship between the chemical structures of these PAs, PAMIs and PAMIPs with their gas transport properties.

Keywords: *Fluorinated poly(ether amide)s, Thermal properties, Mechanical properties, Copoly(ether amide)s-POSS nanocomposite membranes, Gas permeability, Ideal permselectivity.*