Synthesis of Novel Hydroxyl-Functionalized Polyimides of Intrinsic Microporosity with Finely Tuned Gas Separation Properties

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Polyimides made from 4,4-(hexafluoroisopropylidene)diphthalic (6FDA) and commercially available hydroxyl-functionalized diamines, such as 2,4-diamino phenol and 4,6-diamino resorcinol, are among the most CO_2/CH_4-selective polymers currently known with mixed-gas selectivity up to ~ 80.[1] The high selectivity results from very high diffusion selectivity due to tight polymer chain packing induced by strong interaction of the polar OH group and polyimide main chain.[1] However, the high selectivity is coupled with low CO_2 permeability of ~ 5-10 barrer (1 barrer = 10^{-10} cm^3(STP cm cm^{-2} s^{-1} $cmHg^{-1}$). To enhance the permeability while maintaining high selectivity, we synthesized several 6FDA-based polyimides of intrinsic microporosity (PIM-PIs) with a series of newly designed dihydroxl-functionalized diamines. The CO_2 permeability and CO_2/CH_4 selectivity of the PIM-PIs depended strongly on the contortion site in the polyimides, as shown in Figure 1. The most promising 6FDA-based hydroxyl-functionalized PIM-PI was obtained from a Tröger's base OH-diamine (HTB) that showed CO_2 permeability of ~ 70 barrer coupled with CO_2/CH_4 selectivity of 70. The syntheses and structure/property relationships of the various OH-derived polyimides will be discussed in detail.

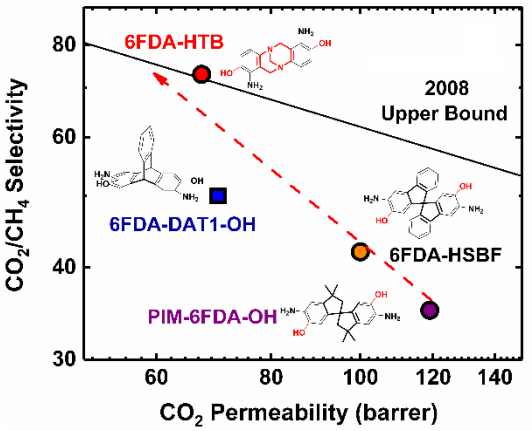


Figure 1. Performance of various hydroxyl-functionalized 6FDA-based polyimides of intrinsic microporosity with structurally different contortion sites.

Reference

1. Stern, S. A.; Kawakami. H.; Houde, A. Y.; Zhou, G. *US 5,591,250*, **1997**.