Polymers of Intrinsic Microporosity and their Membrane Applications

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It has been estimated that 10-15% of world energy consumption goes into the separation of molecular mixtures, often using energy-hungry processes such as distillation.[1] Membranes – thin films that act as selective barriers – offer the prospect of energy efficient separations for many uses, including the supply of pure water, the removal of greenhouse gases, and the manufacture of many of life's necessities. Researchers are seeking to develop membrane materials that can be tailored to give an optimum combination of permeability and selectivity for specific applications.

Polymers of intrinsic microporosity (PIMs) are glassy polymers which possess high free volume and high internal surface area as a consequence of their relatively rigid, contorted macromolecular backbones.[2] They comprise fused ring sequences interrupted by spiro-centres or other sites of contortion. PIMs have a high affinity for gases such as carbon dioxide, and for small organic species. PIMs are being investigated as membrane materials for a variety of separation processes, including gas separations (e.g., carbon dioxide capture) and organophilic liquid separations (e.g., bioalcohol recovery).

In recent years there has been significant research on PIM-based membranes aimed at enhancing selectivity, increasing permeability and improving the long-term performance. This includes (1) new polymer synthesis, (2) manipulation of polymer topology, (3) chemical post-modification of precursor polymers, (4) thermal or ultraviolet treatment of membranes, (5) formation of polymer blends and (6) the addition of various types of filler to form mixed matrix membranes.

References

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