

CHAPTER 1 RATIONALE AND OBJECTIVE

As the new millennium dawns, major new demands are required of the materials we use. Aromatic polyimides are a class of high performance polymers that have excellent thermal, electrical and mechanical properties. They are currently applied in many areas such as aerospace, microelectronic, automotive and gas separation industries as high-temperature coatings, structural adhesives, matrix resins, films, interlayer dielectrics, wire insulation and semipermeable membranes.

Further development of new polyimide systems and modification of existing systems are ongoing tasks to further enhance their desirable properties and applications. One area which has received considerable attention in recent years is selective gas permeation through polymer membranes. Gas purification by semipermeable membranes became economically competitive to cryogenic methods only in the late 1970s. The development of improved polymer material systems for this relatively new application is of great interest.

Commercially viable materials must have both a high permeability and a high selectivity for the gas separations of interest. In recent years, the structure/permeability/selectivity relationships of polymers have become the objective of systematic studies in order to achieve these property characteristics.

The research in this dissertation has focused on the synthesis, characterization and permselectivity properties of high molecular weight, soluble polyimides. The primary interest was to design polymer repeat units, which would yield a highly permeable and highly selective membranes for the O₂/N₂ gas pair. This objective was accomplished by employing two methodologies. The first methodology was to design and investigate novel polyimide systems. Monomer selection was initially based on literature observations. The second methodology utilized monomeric hydroxyl-bearing diamines, which were expected to enhance chain stiffness via intermolecular hydrogen bonding, favorably influence permselective behavior and provide a crosslinkable site suitable for thin films or hollow fiber membranes.

In addition to high permselectivity values, membranes must also be chemically robust. Therefore, this research also focused on crosslinkable polyimides, which, under a given set of conditions, would afford a lightly crosslinked material and thereby increase solvent and contaminant resistance.