

**NUS Graduate School for Integrative Sciences and Engineering
Research Project Write-up**

Title of Project : **Membranes for H₂ and natural gas purification and separation**

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The purification and separation of H₂ and natural gas from other gases is of considerable importance because both of them are high value added energy sources. However, both gases usually contain many other unwanted gases. For example,

1. Process gas from reformer after CO-shift in a gas-fired electricity generating plant in which hydrogen is the major component and water and carbon dioxide are the minor components;
2. Natural gas containing desirable gaseous hydrocarbons and undesirable component such CO₂, H₂S and water. The existence of the acid gas like H₂S and CO₂ in the streams will seriously corrode the pipelines and lower the useful energy content in the gas streams.

The purification and separation by means of selective permeation through membranes, particularly the polymer membranes is one of the fastest growing branches of separation technology due to its easy membrane formation, flexible module fabrication, and especially its low energy cost compared to other conventional technologies. However, the polymeric membrane-based gas separation associated with above mentioned processes involving CO₂ removal has met two immediate challenges:

- 1) The plasticization of the polymeric membranes with the existence of carbon dioxide at extremely high partial pressure;
- 2) The relatively low either H₂/CO₂ or CO₂/H₂ separation factors of various materials.

Therefore, the objectives of this project are:

- To examine new materials or modification approaches that can potentially result in high separation factors in the separation of CO₂ from H₂ and CH₄;
- To fundamentally investigate the separation mechanism of these gas components in the polymeric materials
- to stabilize the membrane performance in the environment with condensable components;
- to explore the possibility of a membrane configuration with higher separation efficiency

Most of the experimental facilities necessary for the proposed work are available:

1. Membrane and module fabrication; 2. Pure gas permeation characterization; 3. Gas mixture separation; 4. Physical properties characterization by FTIR, XPS, AFM, SEM, TEM and XRD.