Chapter V

Conclusions and Further Works

Conclusions

1. The synthesis and characterization of silicalite membrane

The silicalite membrane was synthesized by the hydrogel with a composition of $0.1TPABr\text{-}0.05Na_2O\text{-}SiO_2\text{-}80H_2O$ and characterized by TGA, XRD and SEM. The TGA results showed that the suitable temperature for calcination should be higher than 410 °C. The XRD pattern of this membrane after calcination was almost the same as the standard pattern of silicalite. It showed that this membrane was silicalite membrane. The SEM image exhibited that the crystal sizes and membrane thickness depended upon types and pore sizes of the support. It was found that the smooth surface of the borosilicate disc facilitated the crystal growth of silicalite more than that of the silica fiber. In case of the borosilicate disc support, it was found that the small pore size of the support of 4-5.5 μm, generated small crystal and thin layer of membrane, whereas, the large pore size of 10-16 μm, generated large crystal and thick layer of membrane.

2. The sealing method

The sealing between silicalite membrane and 3-way Parex glass by epoxy resin was applied for leak protection. However, the silicalite membrane cracked because of the shrinkage of epoxy resin, temperature and curing time.

3. Separation performance and selectivity

The silicalite membrane was able to separate p-xylene and m-xylene from o-xylene in mixed xylenes at various ratios in gas phase. The separation of m-xylene from o-xylene caused by the configurational diffusion.

Suggestions and further works

In this experiment, many problems and interested points were found as following:

1. The interference of water to the separation must be avoided. After the calcination, the membrane should be immediately sealed and kept in the desiccator before use.

2. The silicalite membrane cracked because of high pressure of carrier gas and the shrinkage of epoxy resin; therefore new material to replace epoxy resin as a binder or new method using graphite gasket instead of sealing should be tried.

3. The pore size of borosilicate support affected the crystal sizes and thickness of silicalite membrane. It is interesting to study the effect of pore sizes of the borosilicate disc support on the thicknesses of silicalite membrane and the separation performance of membrane.

4. To solve the problem of the silicalite membrane cracking according to the heating and cooling rate, using the programmable oven should be tried.

5. The improvement of a separation of p-xylene from m-xylene by reducing the pore sizes of the silicalite using incorporation of obstructing species such as metal or metal salt [28] should be studied.