Hydrophobic graphene-based membranes with tuneable separation factors for organic solvent separations

Zouaoui Taqwa[*1], Jiang Zhiwei[1], Livingston Andrew[1], Li Kang[1]*
[1]*Barrer Centre, Department of Chemical Engineering, Imperial College London*
**Presenting author: t.zouaoui22@imperial.ac.uk*

Today, 10-15% of global energy consumption is caused by distillation in chemical processes, generally for hydrocarbon separation [1]. An energy-efficient alternative is membrane technology but requires selective differentiation of organic solvents with high permeance. Graphene, a two dimensional single atomic carbon layer, is an attractive material for thin film membrane applications, especially for organic solvent separations as they are chemically inert and mechanically robust.

In our research group, ceramic hollow fibres (CHFs) have been developed for various membrane procesesses. CHFs are synthesized via the phase inversion method. They are an excellent substrate candidate for graphene-based membranes due to their robust mechanical properties and inert chemical nature which enables them to work under extreme conditions. Graphene oxide (GO) membranes were obtained by vacuum coating CHFs with a GO suspension, which were then reduced to fabricate hydrophobic graphene-based membranes.

In this study, two membrane parameters are found to be easily tuneable: the hydrophobicity and the interlayer d-spacing. These membranes were tuned according to the targeted organic solvent mixture to be separated. Hydrophobic graphene-based membranes provide ultra-fast transport of hydrophobic solvents while retaining polar solvents and other comparable size-based solvents. A summary of the permeance of various polar and nonpolar solvents are show in **Figure 1**.

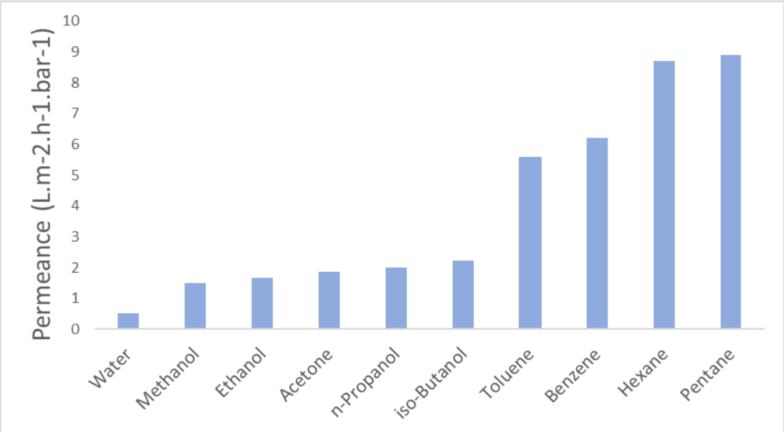

Figure 1: Permeance of pure organic solvents through a 130nm thick reduced graphene oxide membrane as a function of the organic solvent

The promising results obtained prove that reduced graphene oxide has a huge potential to separating organic solvents and crude oil. The high permeance and selectivity can remarkably reduce carbon footprint, which could potentially expand the possibility of using membrane technology as an alternative for distillation processes.

References:
[1] Sholl, D. S. & Lively, R. P. Seven chemical separations to change the world. *Nature* **532**, 435–437 (2016).

Acknowledgements:
ZT was funded by a donation to the Department of Chemical Engineering, Imperial College London by Mr. Mark Richardson.