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# Will ultra-high permeance membranes lead to ultra-efficient processes? Challenges for molecular separations in liquid systems

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## Abstract

An increasing number of reports in the scientific literature describe membranes with ultra-high permeance which might revolutionise molecular separations in liquid systems by making separation processes dramatically more efficient. Many of these reports relate to breakthroughs in materials science, including fabrication of new 2-D materials such as graphene oxide, and structured materials such as metal organic frameworks. Interestingly, the ultra-high permeances described are invariably measured for flat sheet membranes, in highly dilute systems. The effects of pressure gradients across the membrane, and the effects of concentration polarisation at significant, real world concentrations are not usually considered. In practice, membrane modules, rather than flat membrane sheets, are used in industrial processes. In concentrated systems, employing modules, concentration polarisation and module pressure drops will also affect overall process performance. This work examines the extent to which increasing membrane permeance can impact on processes employing membrane modules, considering both spiral-wound and hollow fibre configurations. Our key conclusion is that ultra-high permeance membranes will not be able to make a significant impact on process efficiency with current module designs; and our recommendation is that fresh research into module and process design is required.

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