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Catalyst-membrane synergy as a means of improving process intensity of membrane assisted catalysis

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PURPOSE OF THE ABSTRACT

Homogeneous organometallic catalysis is a technique that has achieved a high level of maturity, and is often an indispensable and reliable method of synthesizing molecular entities produced within several chemical industry sectors.1 These complexes, however efficient as they are, can be expensive and difficult to remove after reaction. This naturally urged the industry to place emphasis on increasing catalyst turnover numbers (TON) and catalyst recovery.2

In this context, recent decades have witnessed a significant growth in industrial interest in solvent based separations using membranes stable to organic solvents,3 due in part to the non-thermal, hence mild and energy efficient nature of the technique. The mild nature of membrane separations makes them particularly suited to integration within reaction systems in which reaction and separation occur simultaneously, a particularly salient example being catalyst recycling.4 Recent membrane developments include ceramic membranes with modified top-layers designed to effect separation not simply on size exclusion alone, but by also making use of solvent ? membrane ? solute interactions. These membranes open up the possibility of designing the membrane surface and the catalyst ligands to achieve the desired rejection profile and reaction performance.

This contribution will highlight the ongoing research aimed at integrating these new membranes into the reaction process and exploiting the synergy between catalyst and membrane surface through which it has been possible to affect an internal catalyst recovery systems. This novel synergetic catalyst-membrane interaction leads to significantly increased catalyst TON's and consequently reduced catalyst load in the reaction. Furthermore, substantial improvements in the sustainability of the process are achieved not only by a reduction in catalyst load and the easy recovery of organometallic species for metal re-processing or salvage. But also the concomitant reaction and product separation leads to a simplified and more sustainable product isolation with low metal contamination.

FIGURES

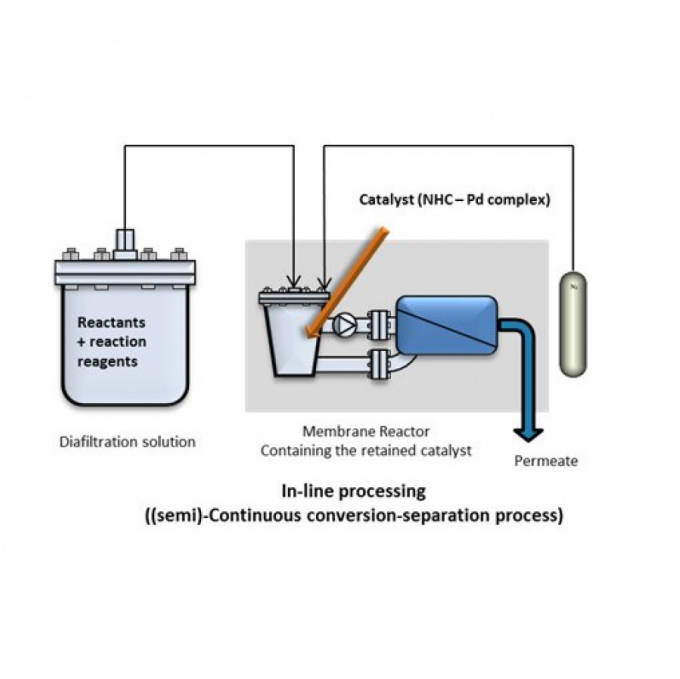

FIGURE 1

membrane assisted cross coupling

Schematic view of the semi-continuous membrane assisted processing method

FIGURE 2

KEYWORDS

Nanofiltration | Catalyst recovery | membrane reactors | improved mass intensity

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