

## Membrane-assisted Processing of Organometallic Catalysed Reactions: From Down-Stream to Continuous Processing

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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. 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. 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]

This contribution will highlight the ongoing research aimed at separating efficiently catalysts under different OSN processing methods namely, online, at-line and off-line.[5] The separation of readily available N-heterocyclic carbene Pd complexes from reaction mixtures with highly stable ceramic membranes will be presented using down-stream processing and continuous-flow synthesis methodologies but also the implementation of new specifically designed N-heterocyclic carbene Pd complexes in a continuous synthesis-separation process (on-line) in which the membrane by efficiently retaining the catalyst is recycling it into the model Suzuki cross-coupling reaction used to demonstrate the principle, resulting in significantly enhanced catalyst TON's.

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[4] I. Vural Gürsel, et al., *Green Chem.*, **2015**, 17(4), 2012-2026.

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