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Flow Suzuki Reactions in the Salamander Reactor Using Pd(II) EnCat™ Catalyst

Pd(II) EnCat™ and a range of encapsulated Pd, Ni and Pt catalysts are available from Reaxa Limited (www.reaxa.com)

Introduction

Pd(II) EnCat™ is a palladium catalyst immobilised in a porous polyurea matrix. The immobilised catalyst takes the form of 200 micron beads which pack well in flow columns and allow flow reactions without building up high back pressures. The Pd(II) EnCat™ has previously been shown to be effective in Suzuki coupling in both batch and flow.[1] This study sought to extend this application to the Salamander Flow reactor.

Method

The flow reactor was set up as shown below with a single inlet connected to an HPLC pump. Flow was directed through a coil to preheat the reaction mixture then via a sampling loop to a glass Omnifit® column filled with 2 g of Pd(II) EnCat™. The outflow passed through a 75 psi back pressure regulator to allow superheating of solvents.

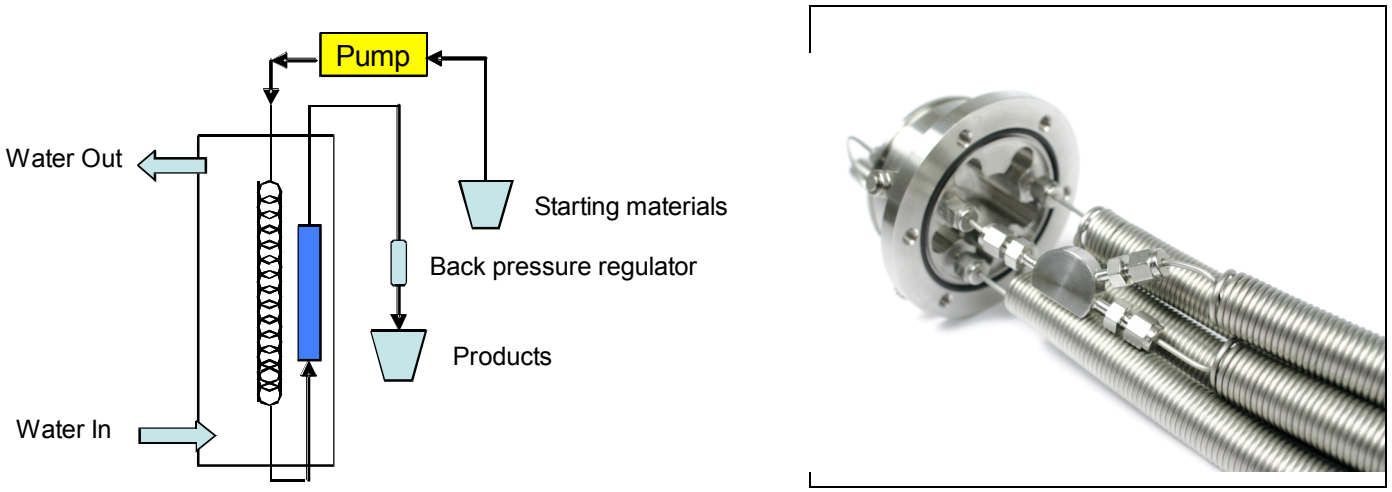

Figure 1. Reactor Set-Up for Flow Experiments

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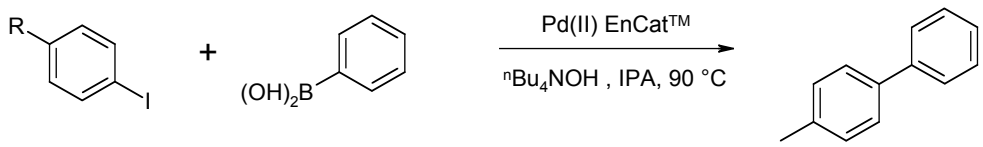
The apparatus was clamped vertically to run the flow against gravity in the column which gives the most even flow of the reagents through the catalyst bed. A water circulator was attached to the jacket and heated to 90 °C.

Results

Suzuki coupling reactions were carried out according to the scheme below. Using the same bed of catalyst, three separate reactions were carried out in succession, washing the flow system with solvent between runs.



Scheme 1: Suzuki flow coupling over Pd(II) EnCat™

The out flow from each reaction was collected and analysed by GCMS.[2] This showed high conversions to the desired product in each case.

Aryl Halide	Conversion to Product
Iodotoluene	86%
Iodoanisole	81%
Iodoacetophenone	90%

Table 1: Results for reactions carried out in three consecutive passes over a column packed with Pd(II)EnCat™.

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Conclusions

Suzuki coupling reactions using a Pd(II) EnCat™ catalyst fixed bed in the Salamander flow reactor resulted in good to excellent conversions to product. The same catalyst bed could be used several times without drop in conversion and allowed a number of coupling products to be rapidly synthesised.

Experimental

Phenyl boronic acid (183 mg, 1.5 mmol) and iodo arene (1.0 mmol) were dissolved in IPA (5 ml), tetrabutylammonium hydroxide base (1.3 ml, 40 wt% in water) was added and the solution was sonicated for 5 min to ensure complete dissolution. The water circulator was set to 90 °C and the reaction mixture was pumped through the flow system at 0.25 ml/min, followed by 10 ml of IPA at 0.5 ml/min. The outflow was collected and analysed by GCMS.

References

1. Connie K. Y. Lee, Andrew B. Holmes, Steven V. Ley, Ian F. McConvey, Bushra Al-Duri, Gary A. Leeke, Regina C. D. Santos, and Jonathan P. K. Seville, *Chem. Commun*., 2005, 2175 - 2177.

2. Reactions were monitored by GCMS using a Varian Saturn 2100T GC/MS instrument with a FactorFour VF-5MS 30 m × 0.25 mm capillary column. Identification and quantification of the products were determined by GCMS analysis and relative yields were based on peak area ratio.