An Amphiphilic Resin-Supported Palladium Catalyst for High-Throughput Cross-Coupling in Water

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Supporting Information

Experimental Section

General. The PS-PEG-adppp (**2**) was prepared on commercially available polystyrene-polyethylene graft copolymer beads, ArgoGel NH₂ (Argonaut Technologies, CA) (1% DVB cross-linked). All starting material were purchased from Ardrich Chemical Co. Inc. and Tokyo Kasei Kogyo Co., Ltd. The agitation of the reaction mixture was performed on a wrist-action shaker (Burrel Scientific, Inc.). and LibraKit™ (Shimazu Scientific Research Inc.).

Preparation of PS-PEG-adppp (2**).** A mixture of paraformaldehyde (0.213 g, 7.09 mmol) and diphenylphosphine (1.35 mL, 7.76 mmol) in methanol (30 mL) was slowly stirred at 70 °C for 1 h under argon atmosphere. After being cooled to ambient temperature, ArgoGel NH₂ (2.00 g, 0.37 mmol/g) and toluene (30 mL) was added to the mixture, and the resulting suspension was stirred for 3 h at ambient temperature. The reaction mixture was filtered and the resin was washed with methanol (30 mL x 3) and dichloromethane (30 mL x 3). The resin was dried under reduced pressure to give **2** (loading of P residue: 1.48 mmol): ³¹P{¹H} NMR (MAS NMR, 162 MHz, chloroform-*d*) δ -28.7 (s).

Preparation of Palladium PS-PEG-adppp Complex (3**).** A Merrifield vessel was charged with resin-supported phosphine **2** (2.29 g, 0.32 mmol/g) and toluene (30 mL). To this suspension was added di(μ-chloro)bis(η³-allyl)dipalladium (II) (142 mg, 0.39 mmol) at ambient temperature and the mixture was agitated with shaking on a wrist-action shaker for 15 min. After filtration, the resin was washed with dichloromethane (30 mL x 3) and dried under reduced pressure to give 2.42 g of **3**: ³¹P{¹H} NMR (MAS NMR, 162 MHz, chloroform-*d*) δ 2.20 (s).

Palladium-catalyzed Cross-Coupling in water. General Procedure for Table 2. A Baker Disposable Filtration Column was charged with **5** (0.5 mmol), **6** (0.6 mmol), K₂CO₃ (2.5 mmol), water (1.65 mL) and Pd-PS-PEG-adppp complex **3** (33 mg, 10 μmol Pd), and the mixture was shaken on a LibraKit™ at 50 °C for 12 h (Schematic view of an individual reaction vessel for the parallel coupling manipulation is shown in **Figure 1**) (note: the coupling reactions were carried out under air atmosphere). The reaction mixture was filtered, rinsed with water (4 mL x 5) and diethyl ether (5 mL x 5). The organic layer was separated, dried over Na₂SO₄ and concentrated under reduced pressure. The residue was filtered through silica gel pad (eluent, hexane) to give **7**. The purity and GC yield of the product were determined by GC analysis of the filtrate with an appropriate internal standard.

Figure 1. A reaction vessel for parallel reactions