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Bimetallic nickel-palladium nanoparticles supported on multi-walled carbon nanotubes for Suzuki and Sonogashira cross-coupling reactions in continuous flow

By: Coker, Katherine A.; Winkleman, Harlee B.; Siamaki, Ali R.

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The advancement of metal-catalyzed carbon-carbon bond forming reactions represents one of the most signif icant contributions to contemporary organic synthesis. Innovations in the area of palladium catalyzed homoge neous cross-coupling catalysis have dominated this area of chem. and are playing an increasingly important role in the area of pharmac eutical drug discovery and develo pment. However, the use of these catalysts under homogeneous conditions has limited their com. viability due to product contami nation as a direct result of inability to effectively sep. the catalyst from the reaction product. Ligand-free heterogeneous catalysis presents a promising option to address this problem as evidenced by the significant increase in research activity in this area. We have recently developed a simple, one-step method for the preparation of bimetallic nickel-palladium nanoparticles supported on multi-walled carbon nanotubes (Ni-Pd/MWCNTs) under mech. shaking in a ball- mill. The preparation method is very fast and straight forward which does not require any chems., solvents, or addnl. ligands. Notably, the concentration of palladium can be lowered to a min. amount of 1% and replaced by more abundant and less expensive nickel nanoparticles while effectively catalyzing the reaction. The as-prepared nanoparticles demonstrated remarkable catalytic activities in cross- coupling catalysis such as Suzuki and Sonoga shira reactions with functionalized substrates in batch with high turnover number in a single catalytic reaction. Batch operations have several inherent limitations that include reproducibility, scalability, and reactor productivity. Continuous flow chem. has been considered as an altern ative approach in academic and industrial processes due to its efficient and innovative synthetic design. The low palladium loading and excellent recyclability of the catalyst make this an affordable and clean option for cross- coupling catalysis under continuous flow condit ions, a feature that enables the large-scale industrial and pharmaceutical applications of this method in the future.

Conference

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