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Synthesis of Pd Nanoparticles Confined in Graphene Oxide Framework as Nano Catalyst with Improved Activity and Recyclability in Suzuki-Miyaura Cross-Coupling Reaction

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Abstract : Recently, covalently linked graphene oxide frameworks (GOFs) have attracted considerable attention in gas absorbance and water purification as well-defined microporous materials. In spite of their potential advantages such as a controllable pore dimension, adjustable hydrophobicity, and structural stability, these materials have been scarcely employed in heterogeneous catalysis. Here we demonstrate a novel and facile method to synthesize Pd nanoparticles (NPs) confined in a GOF (Pd@GOF). The GOF with uniform interlayer space was obtained by the intercalation of diboronic acid between graphene oxide layers. It was found that Pd NPs were generated inside the graphitic gallery spaces of the GOF, and thus, formed Pd NPs were well-dispersed with a narrow particle size distribution. The synthesized Pd@GOF emerged as an efficient nanocatalyst based on its superior performance (product yield and recyclability) toward Suzuki-Miyaura cross-coupling reaction in both polar and apolar solvents, which has been hardly observed for previously reported graphene-based Pd nanocatalysts. Furthermore, the rational comparison of the catalytic performance between two kinds of Pd@GOF (Pd NPs encapsulated in a diboronic ester-intercalated GOF and in a monoboronic ester-intercalated GOF) firmly confirmed the essential role of a rigid framework design in the stabilization of Pd NPs. Based on these results, the covalently assembled GOF was proposed as a promising scaffold for hosting noble metal NPs to construct desired metal@GOF nanocatalysts with improved activity and durability.

Keywords : graphene oxide framework, palladium nanocatalyst, pore confinement, Suzuki-Miyaura cross-coupling reaction
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