Development of New Catalytic Performances of Nanoporous Metals for Molecular Transformations

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Introduction

Nanoporous metals are promising materials for catalysis, sensing, and actuation applications due to their interesting structural, optical and surface properties. In spite of the growing number of studies on various applications of nanoporous metals, the catalytic properties in chemical reactions are still less explored. In this regard, we have focused on the study of new catalytic properties of the unsupported nanoporous metals in heterogeneous molecular transformations under liquid phase conditions.

Results and Discussion

1) Nanoporous Copper Catalyst in Click Chemistry: Nanoporosity-Dependent Activity without Supports and Bases

Nanoporous copper (CuNPore) catalysts with tunable nanoporosity were fabricated from $Cu_{30}Mn_{70}$ alloy by controlling the dealloying temperature under free corrosion conditions. The tunable nanoporosity of CuNPore led to a significant enhancement of catalytic activity in click chemistry without using any supports and bases. Characterization of CuNPore surface, high reusability, leaching experiment, and formation of nanostructured copper acetylide revealed that the click reaction occurred at the catalyst surface.

2) Nanoporous Gold Catalyst for Highly Selective Semihydrogenation of Alkynes: Remarkable Effect of Amine Additives

We report for the first time the highly selective semihydrogenation of alkynes using the unsupported nanoporous gold (AuNPore) as a catalyst and organosilanes with water as a hydrogen source. Under the optimized reaction conditions, the present semihydrogenation of various terminal- and internal-alkynes affords the corresponding alkenes in high chemical yields and excellent *Z*-selectivity without any over-reduced alkanes. The use of DMF as solvent which generates amines *in situ*, or pyridine as an additive is crucial to suppress the association of hydrogen atoms on AuNPore to form H_2 gas which is unable to reduce alkynes on the unsupported gold catalysts.

3) Unsupported Nanoporous Gold Catalyst for Highly Selective Hydrogenation of Quinolines

We report for the first time the highly efficient and selective hydrogenation of substituted quinolines using the unsupported nanoporous gold (AuNPore) as a catalyst and organosilane with water as a hydrogen source. The AuNPore catalyst can be readily recovered and reused without any loss of catalytic activity.