Silica-Supported Cu_2O Nanoparticles in Advancement of Ullmann Reaction

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Ullman condensation or Ullman C-O arylation is a reaction that uses Cu metal and thermal conditions to convert aryl halide and phenolic compounds to aryl ethers. The catalytic performance of silica-based nanoparticles of Cu_2O (Cu_2O-NP) on Ullmann C-O arylation was studied by varying the amount and the ratio of Cu_2O-NP: silica combination while keeping the amount of reactants and all other conditions constant. Iodobenzene and phenol were used as C-O arylation precursors in the presence of Cu_2O-NP on silica in DMSO and K_2CO_3 at the reflux condition. In parallel, we performed the same reaction under conventional conditions in that the Cu_2O-bulk material was used as the monitoring system. The product formation of the reaction was monitored by using TLC and gas chromatography methods. Cu_2O-NP and supported silica demonstrated significant catalytic activity in the Ullmann C-O arylation. Among the various ratios of Cu_2O-NP and silica catalysts, maximum yield (52%) of diphenyl ether was obtained for the catalyst mixture of Cu_2O-NP: silica (2:1 W/W) and the Cu_2O-NP: iodobenzene (1:20 mole ratio) while 63% yield of diphenyl ether was obtained in the conventional method where Cu_2O bulk: iodobenzene (1:1 mole) ratio was used. Moreover, with silica-based Cu_2O-NP as the catalyst, the reaction temperature was successfully reduced from 180°C (conventional method) to 160°C (with Cu_2O-NP and silica). Accordingly, the Ullman C-O arylation was enhanced economically and environmentally benign manner with the support of Cu_2O-NP and silica.

Keywords: Cu_2O-Nanoparticles, Silica Supported Cu2O-Nanoparticles, Ullmann C-O Arylation, Ullmann Reaction