Investigation of copper oxide nanoparticles as catalysts for "Click reaction"

S kukendran, HIC de Silva and SM Vithanarachchi#

Department of Chemistry, Faculty of Science, University of Colombo, Sri Lanka
#sashimv@chem.cmb.ac.lk

1,3-Dipolar cycloaddition reaction between azides and terminal alkynes has gained great interest in the recent years. Copper salts have been used as catalysts over the past years to make the reaction more efficient. However, reusability of the Cu salts is questionable. Therefore, instead of Cu salts, CuO nanoparticles were tested to be used as catalysts for 'Click' reaction. In this research, CuO nanoparticles synthesized using extracts of coriander seed and leafby co-precipitation method was studied as a catalyst for 'Click' reaction. Our previous research found extracts of coriander seed and leaf can stabilize nanoparticles. FT-IR spectroscopy and Scanning electron microscopy showed the formation of nanoparticles of size smaller than 100 nm.'Click' reactions were carried out in the presence and absence of a reducing agent (ascorbic acid) and its catalytic activity was compared with chemically synthesized CuO nanoparticles, and a copper salt (CuSO4). The yields obtained and times taken for completion of the reaction were compared to identify a better catalyst. Further, the reusability of CuO nanoparticles and their catalyst loading were also investigated. The results showed that green synthesized nanoparticles have catalytic activity giving a higher yield (86%) in shorter reaction time (45 min) when reaction was carried out at 75 °C between benzyl azide and phenyl acetylene in 1:1 ratio. Further, green synthesized CuO nanoparticles did not require ascorbic acid as the reducing agent whereas copper salts (85% yield in 45 min) and chemically synthesized CuO nanoparticles (48% yield in 45 min) required the reducing agent. As CuO nanoparticle is a heterogeneous catalyst, it can be separated easily from the reaction mixture. Studies showed green synthesized CuO nanoparticles can be reused at least three times giving consistent yields. In preliminary studies, green synthesized CuO nanoparticles had a higher catalyst loading than the copper salts (20 mol %). However, further studies revealed that the catalyst loading can be reduced with optimization of reaction conditions. The studied green synthesized CuO nanoparticle is a promising inexpensive and more efficient catalyst for 'Click' reaction that can be easily separated and reuse.

Keywords: nanoparticles, green synthesized, click reaction