Utilization of Carbon Monoxide as a Reducing Agent for C-C and C-N Bond Formation: Application to Asymmetric Catalyst and Synthesis of New Effective Fungicide

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Due to toxic industrial waste environmental pollution due has become one of the most significant problems nowadays. Most widely-used method of utilization of carbon monoxide, a poisonous byproduct of steel manufacture, is its combustion ($CO+O2=CO2$). Here carbon monoxide acts as a reducing agent, and we wondered if it was possible to put its reducing properties to good use without consumption of any essential substances (such as oxygen). We found the answer in oxidation of carbon monoxide to carbon dioxide during the reaction of a new type: «Reductive alkylation and amination in presence of carbon monoxide without an external hydrogen source». The goal of this project was to study advantages of the method of carbon monoxide utilization and to reveal new possibilities of the reaction that could be introduced to organic synthesis. We applied it to the synthesis of potential biologically and catalytically active compounds. As a result we offered a new highly selective one-step energy-saving method of C-C and C-N single bond formation without external hydrogen source, which can replace traditional two-step approaches. The studied method allows straight C-C and C-N bond formation without any effect on functional groups. Meanwhile, a new effective fungicide and two chiral catalysts were synthesized, which demonstrated high activity. In addition, we report a new potential method of synthesis of pyrrolidines, which form during a rearrangement, that occurs in reaction between primary amine and methylcyclopropylketone in the presence of carbon monoxide. Results of our project demonstrate the advantages of the developed method of utilization of toxic industrial waste, which makes some new unexpected reactions possible.

Awards Won:

Second Award of $2,000

American Chemical Society: Fourth Award of $1,000

Sigma Xi, The Scientific Research Honor Society: First Physical Science Award of $2,000