

One-component and Non-ionic Cr-, Mo-, and W-based Catalysts for Conversion of CO₂ and Epoxides into Cyclic Carbonates

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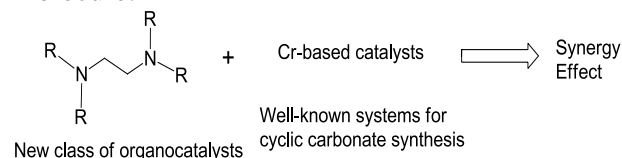
The increase in atmospheric carbon dioxide concentration is an urgent global issue. Extensive research, including CO₂ emission reduction, carbon capture and sequestration (CCS), and carbon capture and utilization (CCU) are actively underway to alleviate atmospheric CO₂ levels [1].

From a synthetic chemists' perspective, CO₂ is an attractive C1 feedstock [2]. As a chemical, carbon dioxide is safe, abundant and renewable. However, it is highly oxidized and thermodynamically stable, therefore chemical activation requires a significant amount of energy input. Nevertheless, many synthetic systems have successfully developed and various chemicals are now being made from CO₂, including commercial productions of urea, methanol, cyclic carbonates, polycarbonate, and sodium 2-hydroxybenzoate.

One of the most active areas of CO₂ conversion is the coupling of CO₂ and epoxides to produce the corresponding cyclic carbonates. Since cyclic carbonates have many uses such as aprotic solvents, electrolytes for secondary batteries, monomers for polymers, and pharmaceutical intermediate, various new catalytic systems for the synthesis of cyclic carbonates have been reported in the literature [3].

In general, the efficient catalytic systems for cyclic carbonates consist of two components including metal-based compounds for epoxide coordination and ammonium salt as a nucleophile for the ring opening. The typical example for two component systems is LTi(O-*i*-Pr)₂ (L = pyridine-based tridentate ligand) and *n*-Bu₄NI, which we recently reported in the literature [4]. One-component catalytic systems for cyclic carbonates are very

rare and known catalysts have a form in which the ligand coordinated to the metal center comprises an ammonium salt [5]. To the best of our knowledge, there have been no reported studies on one-component and neutral catalytic systems containing no tethering salts in a molecule.



Recently, we reported tertiary amines as a new class of highly efficient organocatalysts for the synthesis of cyclic carbonates [6]. In addition, many chromium-based compounds are known to be very active catalysts for the cycloaddition reaction [7]; however, no examples of their congeners such as molybdenum- and tungsten-based compounds as catalysts for the coupling reaction of CO₂ and epoxides are reported in the literature.

In the symposium, we will report the synthesis of new Cr-, Mo-, and W-based compounds containing bidentate tertiary amines and their application as catalysts in the absence of any additives for the synthesis of cyclic carbonate.

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