Aluminum-based Catalysts for the Coupling of Carbon Dioxide and Epoxides

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Cyclic carbonates are very valuable materials for the use as polar aprotic solvent, electrolytes for secondary batteries, monomers for polymers, and pharmaceutical intermediate, various new catalytic systems for the synthesis of cyclic carbonates. The coupling of carbon dioxide and epoxides using by a wide variety of catalytic systems, including metal-based catalysts and non-metal organocatalysts has been intensively studied over the past few decades [1]. Although some excellent catalysts have been reported for this reaction, research on new catalysts that can operate efficiently under the mild condition is still important.

Some efficient aluminum compounds for the synthesis of cyclic carbonates from CO_2 and epoxides have been reported in the literature [2-9]. Until now, much of the investigation focused on aluminum catalysts has been directed toward two research topics: (1) the chelating mode change such as bidentate [2], tridentate [2], or tetradentate fashion [3-12] and (2) the modification of substituents on the aromatic ring of tetradentate salen [3-10] or tri(phenolateamine) ligands [11,12].

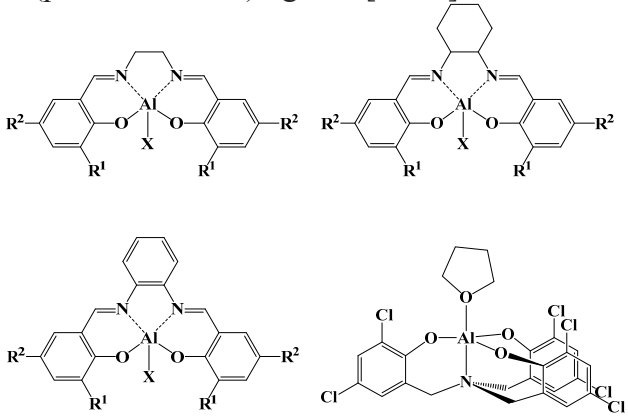

Figure 1. Well-known catalytic systems containing tetradentate ligands

As shown in Figure 1, only three types of salen ligands with ethylene-[3-5], cyclohexylene-[6-9], and phenylene-bridge [10] for aluminum-based catalysts have been reported in the literature.

In the symposium, we will report the synthesis of new Al-based compounds containing tetradentate salen-type ligands bridged by naphthalene, 4,5-dimethylphenylene, and 4,5-dichlorophenylene groups and their application as catalysts for the synthesis of cyclic carbonate under the mild condition of room temperature, 5 bar CO_2 pressure, and low catalyst loading of 0.5 mol%. In addition, we will compare the catalytic activity using our Al compounds with that for reference compounds shown in Figure 1.

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