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Preparation of Ternary Metal Oxide Aerogel Catalysts for Carbon Dioxide and Propylene Oxide Cycloaddition Reaction

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Abstract : CO2 is the primary greenhouse gas which causes global warming in recent years. As the carbon capture and storage (CCS) getting maturing, the reuse of carbon dioxide which made from CCS is the important issue. In this way, the most common method is the synthesis of cyclic carbonate chemicals from the cycloaddition reaction of carbon dioxide and epoxide. The catalyst plays an important role in the CO2/epoxide cycloaddition reactions. The Lewis acid and base sites are both needed on the catalyst surface for the help of epoxide ring opening, leading to the synthesis of cyclic carbonate. Furthermore, the larger specific surface area and more active site of the catalyst are also needed to enhance the efficiency of the CO2/epoxide cycloaddition reactions. Aerogel is a mesoporous nanomaterial (pore size between 2~50 nm) with high specific surface area and porosity (at least 90%) and low density. In this study, the ternary metal oxide aerogels, Mg-doped Al2O3 aerogels, with higher specific surface area and Lewis acid and base sites on the aerogel surface are successfully prepared by using a facile sol-gel reaction. The as-prepared Mg-doped Al2O3 aerogels are also served as heterogenous catalyst for the CO2/propylene-oxide cycloaddition reaction. Compared to the pristine Al2O3 aerogels, the Mg-doped Al2O3 aerogels possessed both Lewis acid and base sites on the surface are able to enhance the efficiency of the CO2/propylene oxide cycloaddition reactions. As a result, the as-prepared Mg-doped Al2O3 aerogels are a promising and novel catalyst for the CO2/epoxide cycloaddition reactions.

Keywords : ternary, metal oxide aerogel, CO2 reuse, cycloaddition, propylene oxide
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