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Glycerol carbonylation with CO_2 to producing the glycerol carbonate over metal oxide nanoparticle catalyst and the influence of both the calcination temperature of the catalyst and the reaction parameters

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Four types of metal oxide nanoparticle catalysts (La_2O_3, NiO, CuO, and Co_3O_4) are prepared by precipitation method and used for the synthesis of glycerol carbonate from the direct carbonylation of glycerol and carbon dioxide in the presence of dehydrating agent and solvent. The effects of calcination temperatures, dehydrating agents, and reaction parameters on the conversion of glycerol and yield of glycerol carbonate are investigated. XRD, FT-IR, SEM, BET, CO_2-TPD, and H_2-TPR are used for the characterization of the prepared catalysts. It is found that the efficient catalyst for the carbonylation of glycerol should have not only large amount of basic sites and surface area, but also high redox ability and oxygen vacancy. CuO with calcination at 400°C exhibits higher catalytic activity and the best dehydrating agent is 2-cyanopyridine. The active site of CuO catalyst may be crystal face (111). Under condition of 150°C, 4 MPa, 5 h, the glycerol carbonate yield can reach about 40%. The catalyst can be reused five times with little loss of activity and can be easily regenerated by calcination at 400°C.

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