Synthesis of glycerol carbonate from glycerol and urea over Zn/Al mixed oxide catalysts supported by activated red mud

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The synthesis of glycerol carbonate via the reaction between glycerol and urea was investigated with Zn/Al mixed oxide ($MOX_{Zn/Al}$) catalysts supported by activated red mud (ARM), an abundant waste material from aluminum production. Zn and Al were impregnated onto ARM by hot wet impregnation with various molar ratios of Zn:Al and various metal weight loadings. A series of $MOX_{Zn/Al}$ catalysts without ARM was also prepared for comparison. The reactions were carried out under vacuum condition (3kPa) at 140°C. Compared to unsupported $MOX_{Zn/Al}$ catalysts, ARM-supported $MOX_{Zn/Al}$ catalysts exhibited higher yields of GC, even at lower $MOX_{Zn/Al}$ loadings. The catalytic performance of ARM-supported $MOX_{Zn/Al}$ catalysts showed a volcano curve for the GC yield as a function of the Zn/Al loading. The maximum GC yield of 59.8% was attained by the 50%-$Zn_7Al_3O_x$/ARM catalyst, compared to 49.6% for $Zn_7Al_3O_x$. FTIR analysis revealed the ARM-supported MOXZn/Al catalysts to be more selective to GC, resulting in higher selectivity and GC yield. The balance of the active sites from ARM and $MOX_{Zn/Al}$ is related to the rate of each reaction step in GC synthesis, which eventually influences the selectivity and yield of GC.