Supplementary Information

Oxidative esterification of ethylene glycol in methanol to methyl glycolate over Au/ZnO catalysts: effect of preparation methods

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The catalytic performance of Au/ZnO catalysts in the one-step oxidative esterification of ethylene glycol to MG was evaluated. Given that the optimal reaction conditions may vary for different catalysts, the influence of reaction temperature and time were tested for each catalyst at a pressure of 3 MPa and a catalyst dosage of 0.3 g. Initially, the reaction temperature was optimized, followed by the optimization of the reaction time at the optimal temperature. The results are presented in Figure S1. Overall, the conversion of EG increased with higher reaction temperature and longer reaction time. However, this also led to a decrease in MG selectivity, due to excessive oxidation. The results revealed that the Au/ZnO-IM catalysts exhibited the best performance at 110 °C for 3.5 h. The Au/ZnO-CD and Au/ZnO-DP catalysts showed the best performance at 100 °C for 3.5 h. The Au/ZnO-CP catalysts showed the best performance at 100 °C for 4 h.

The stability test on the Au/ZnO-DP catalyst was performed, and the results are shown in Figure S2. It can be seen that the EG conversion was significantly reduced when the catalyst was reused twice and three times, to 60.7% and 47.8%, respectively. In contrast, the selectivity of MG did not change significantly.

The XRD characterization showed that noticeable Au diffraction peaks emerged in the spent catalyst, as shown in Figure S3, in comparison to the fresh catalyst. This suggests that during the oxidative esterification reaction, the size of Au particles notably increased. Figure S4 shows the TEM image of the spent Au/ZnO-DP catalyst. The average size of the gold particles was found to increase to 8.9 nm compared to

the that of fresh Au/ZnO-DP catalyst (3 nm), which may be the reason for the significant decrease in the EG conversion.

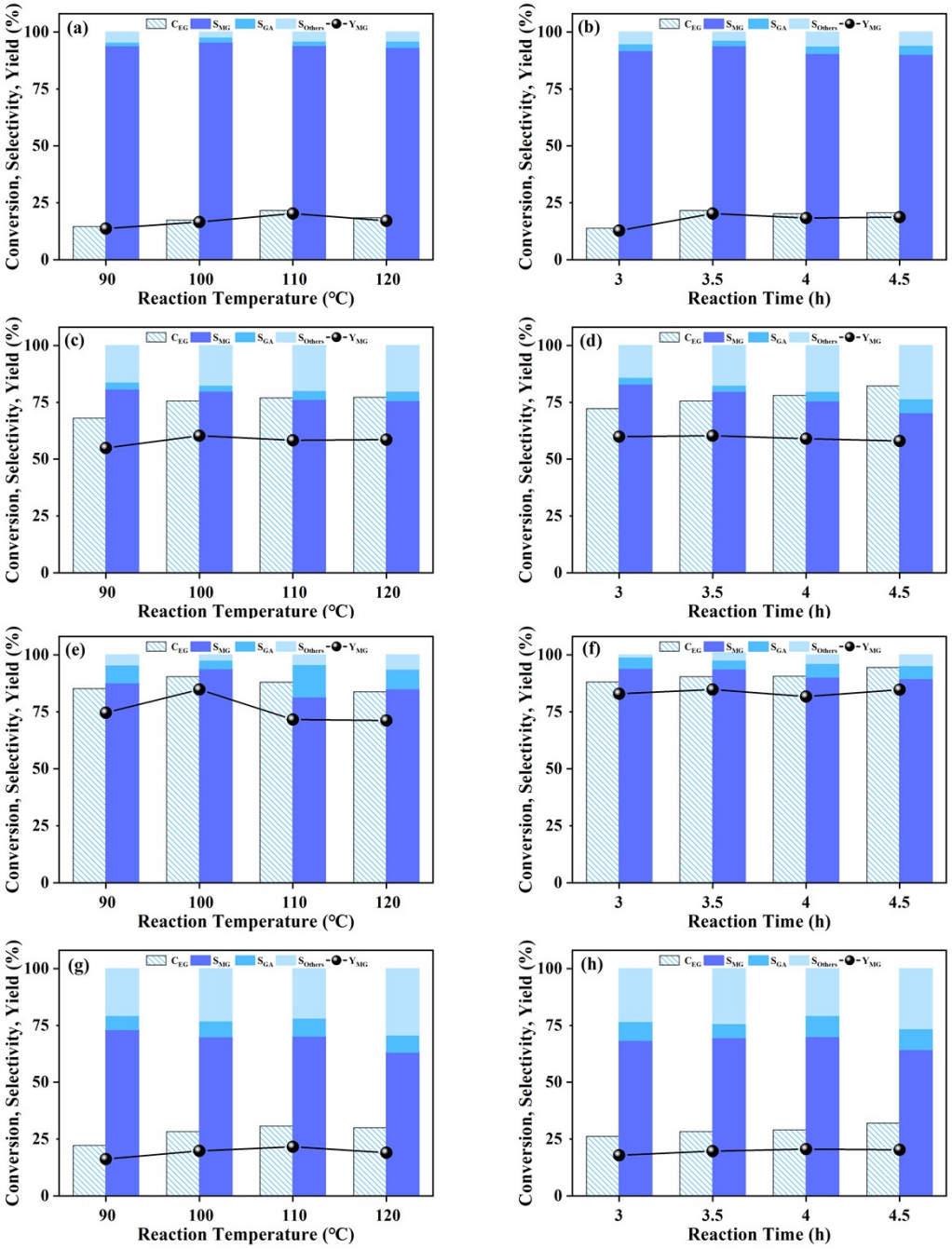

Figure S1 Optimization of reaction conditions for Au/ZnO-IM (a and b), Au/ZnO-CD (c and d), Au/ZnO-DP (e and f) and Au/ZnO-CP (g and h)

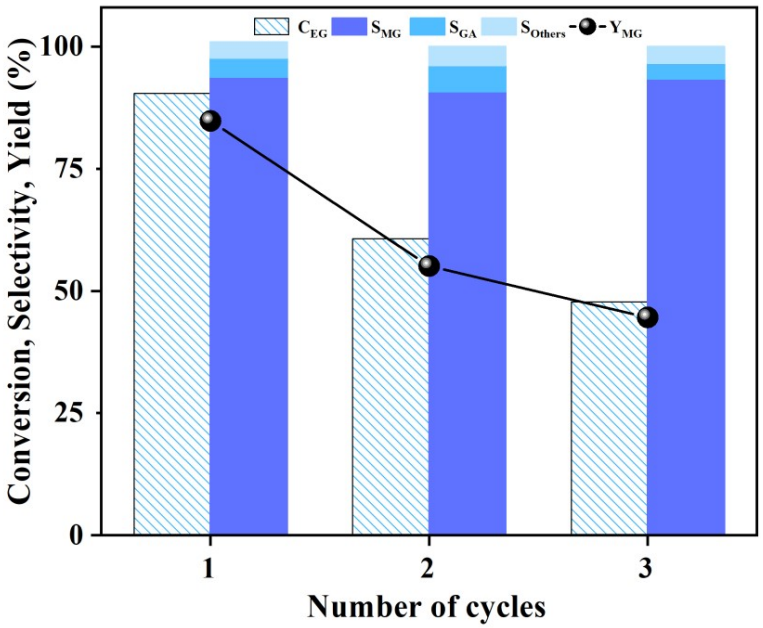

Figure S2 Cyclic stability of Au/ZnO-DP catalyst

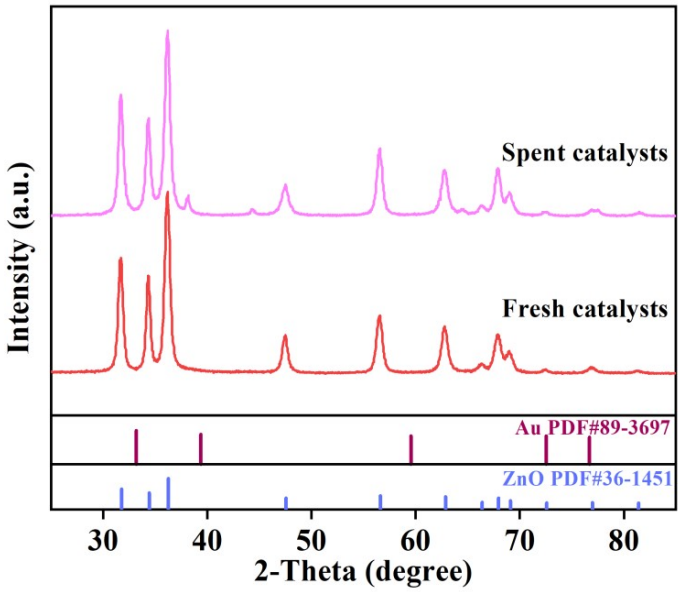

Figure S3 XRD patterns of fresh and spent Au/ZnO-DP catalysts

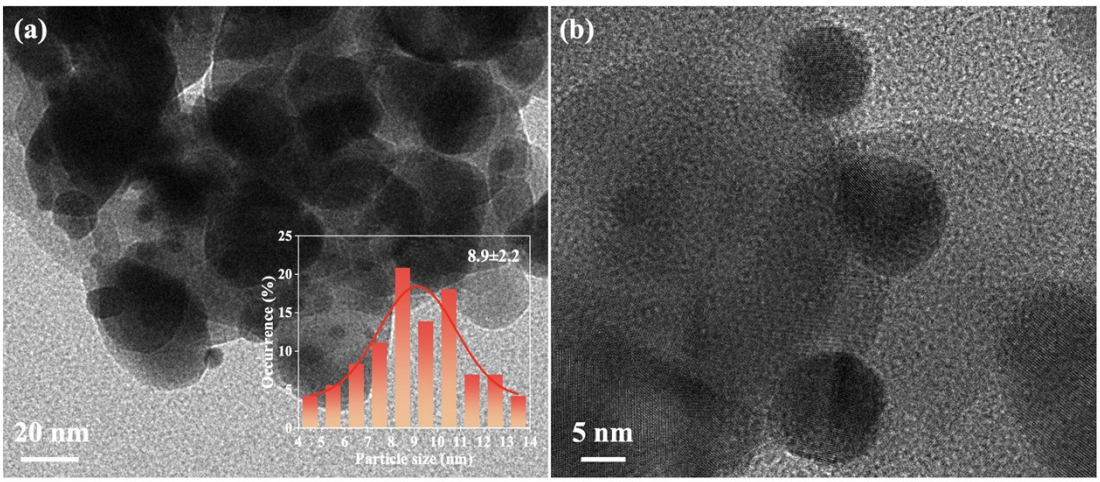

Figure S4 TEM images of spent Au/ZnO-DP catalyst