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SUPPLEMENTARY MATERIAL TO

Water glass derived catalyst for the synthesis of glycerol carbonate via the transesterification reaction between glycerol and dimethyl carbonate

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Determination of basic strength and total basicity of catalysts

The basic strength of the catalysts was determined by Hammett indicator method. The employed indicators were bromothymol blue (*H*_7.2), phenolphthalein (*H*_9.8), 2,4-dinitroaniline (*H*_15.0) and 4-nitroaniline (*H*_18.4). After the catalyst was dispersed in cyclohexane, Hammett indicator solutions (0.5 wt.% indicator in benzene) were added to the suspension, respectively. The colour change of the indicator on the surface of the catalyst was recorded.

The total basicity of the catalysts was determined by titration method. First, 100 mg of the catalyst was added to the 10 mL solution of HCl (0.50 mol L^{-1}), stirred at room temperature for 24 h, and filtrated. After filtration, phenolphthalein indicator solution (1 wt. % in ethanol) was added to the remained solution. The remained HCl in the solution was titrated with a solution of NaOH (0.1 mol L^{-1}). The total basicity of the catalyst was calculated according to the amount of HCl reacting with the catalyst.

Calculation of the glycerol conversion, %, and GC yield, %

$$\text{Glycerol conversion} = 100\frac{\text{Initial mole amount of glycerol} - \text{Residual mole amount of glycerol}}{\text{Initial mole amount of glycerol}}$$

$$\text{GC yield, \%} = 100\frac{\text{Mole amount of GC}}{\text{Initial mole amount of glycerol}}$$

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XRD investigation of the fresh WG-2.0 and the five times reused WG-2.0

To observe the structural changes of WG-2.0 in the reuse experiment, the XRD patterns of the fresh WG-2.0 and the five times reused WG-2.0 were compared and the results are shown in Fig. S-1. The characteristic peaks at 15.0, 21.5, 22.6, 23.6, 23.5, 29.3, 30.1, 33.8, 34.8 and 37.1°, which were observed in the fresh WG-2.0, still existed in the five times reused WG-2.0. No obvious changes could be observed in the XRD diffraction pattern of the five time reused WG-2.0, indicating that the crystalline structure of WG-2.0 did not change after five times reuse.

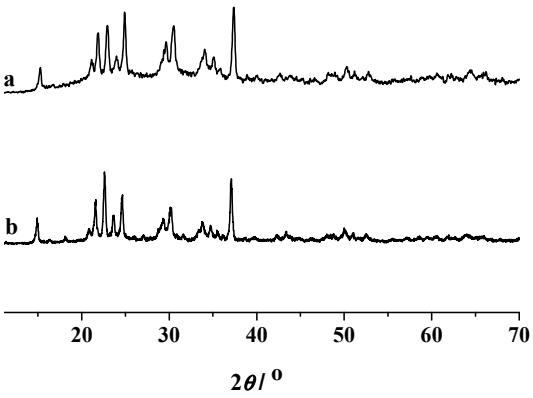

Fig. S-1. XRD patterns of: a) the fresh WG-2.0 and b) the five times reused WG-2.0.

FTIR investigation of the fresh WG-2.0 and the five times reused WG-2.0

In addition, the FT-IR patterns of the fresh WG-2.0 and five times reused WG-2.0 were also conducted to investigate further the structural changes of WG--2.0. The results are shown in Fig. S-2. All the characteristic bands observed in

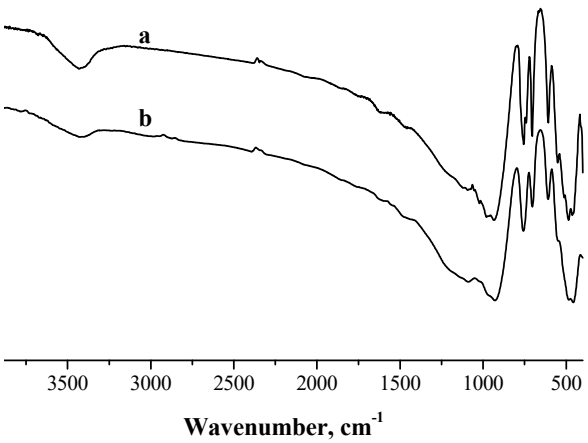

Fig. S2. FTIR of: a) the fresh WG-2.0 and b) the five times reused WG-2.0.

the fresh WG-2.0 were still preserved in the five times reused WG-2.0. These unchanged characteristic bands made the functional groups of WG-2.0 well kept after five times reuse, demonstrating the structural stability of WG-2.0 during the reaction.