Electronic supplementary information (ESI)

A green approach for preparation of surfactant embedded sulfonated carbon catalyst towards glycerol acetalization reaction

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Section S1: FESEM images and corresponding particle size distributions

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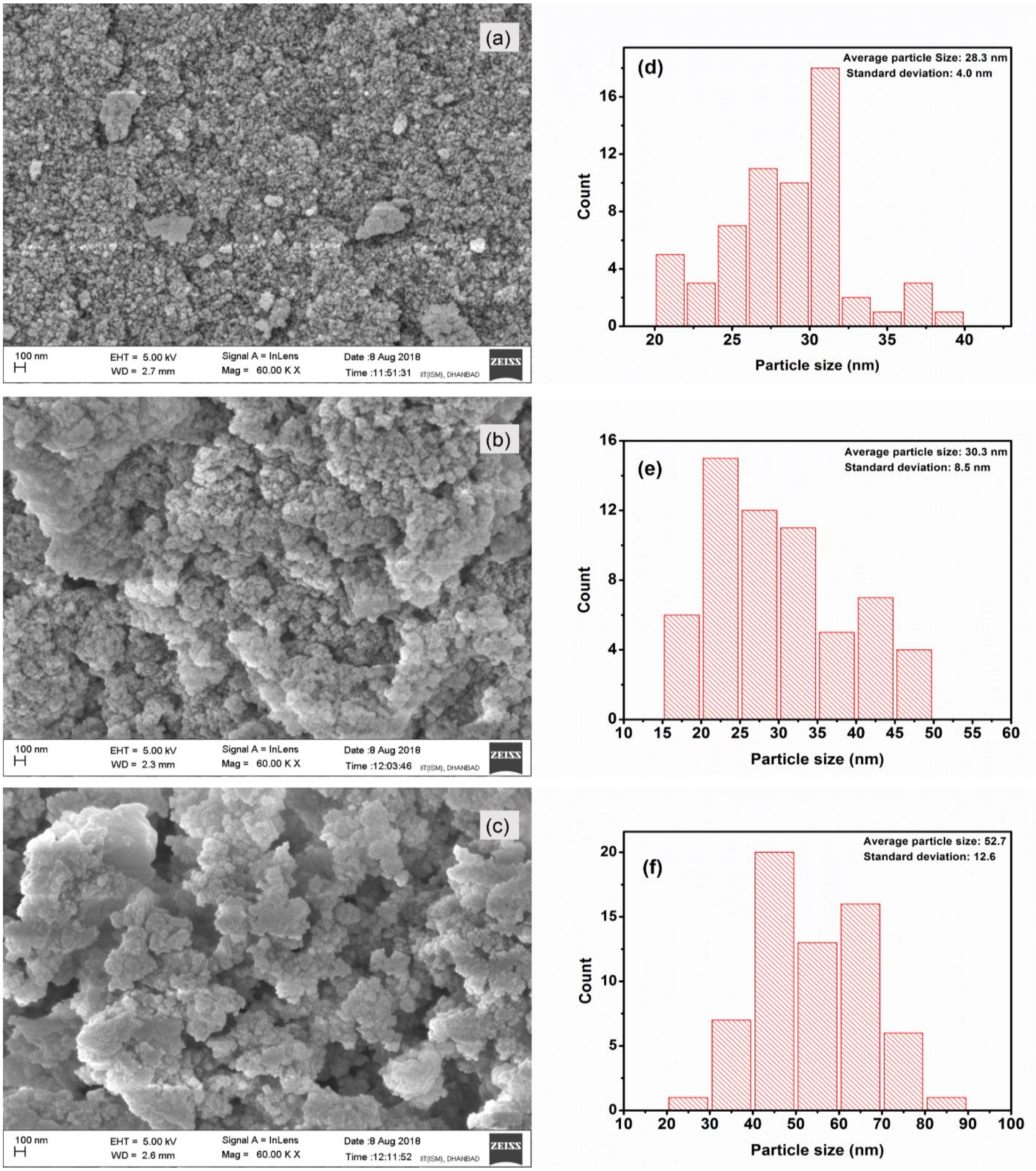


Figure S1. FESEM images (100 nm scale) of (a) G-SO3H, (b) GL-SO3H, and (c) GS-SO3H catalysts. Images (d) to (f) show their respective particle size distributions (histograms).

Section S2: XPS and CHNS/O analysis

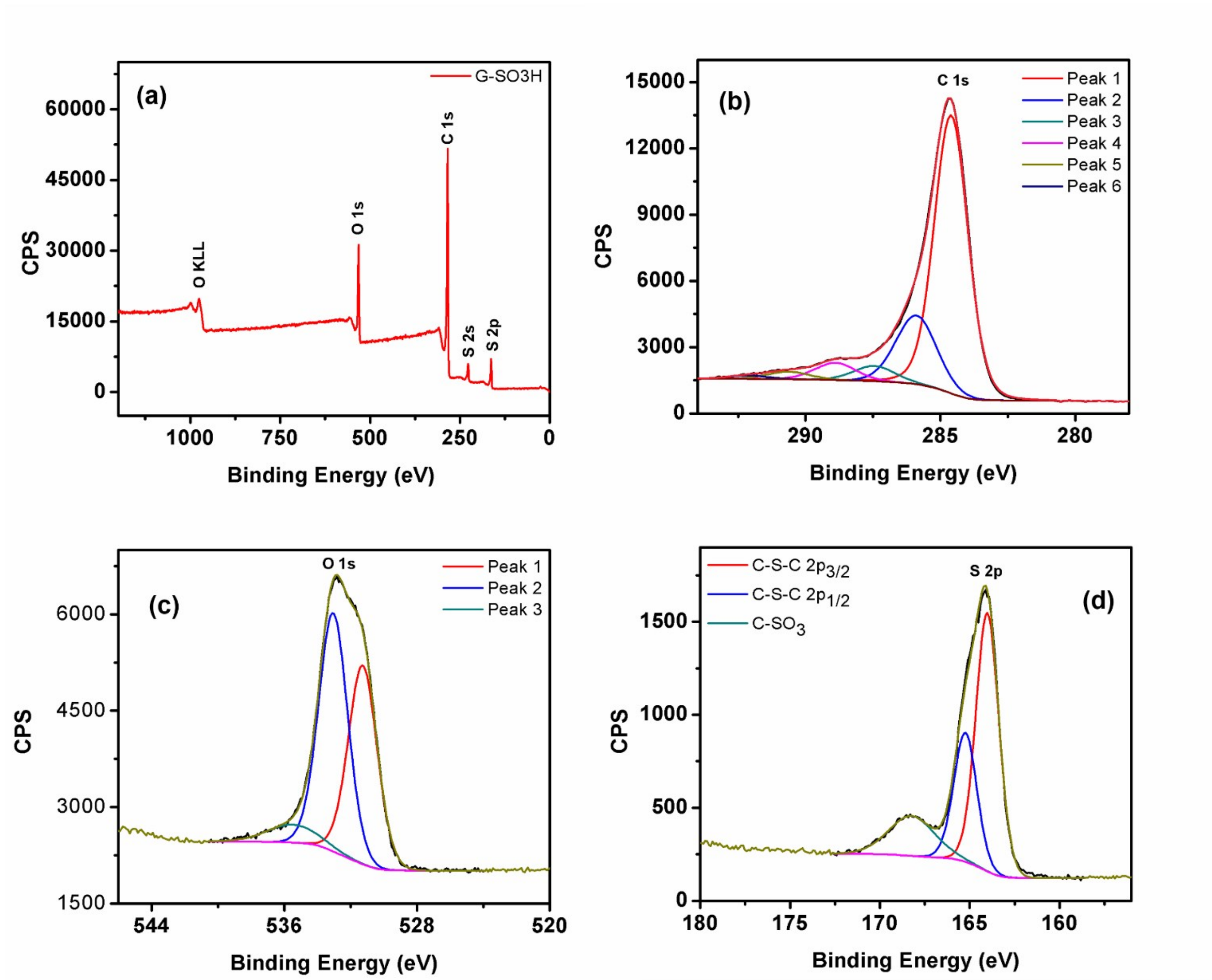


Figure S2. XPS survey spectrum (a) and core-level spectra of C 1s (b), O 1s (c), and S 2p (d) for the G-SO3H catalyst.

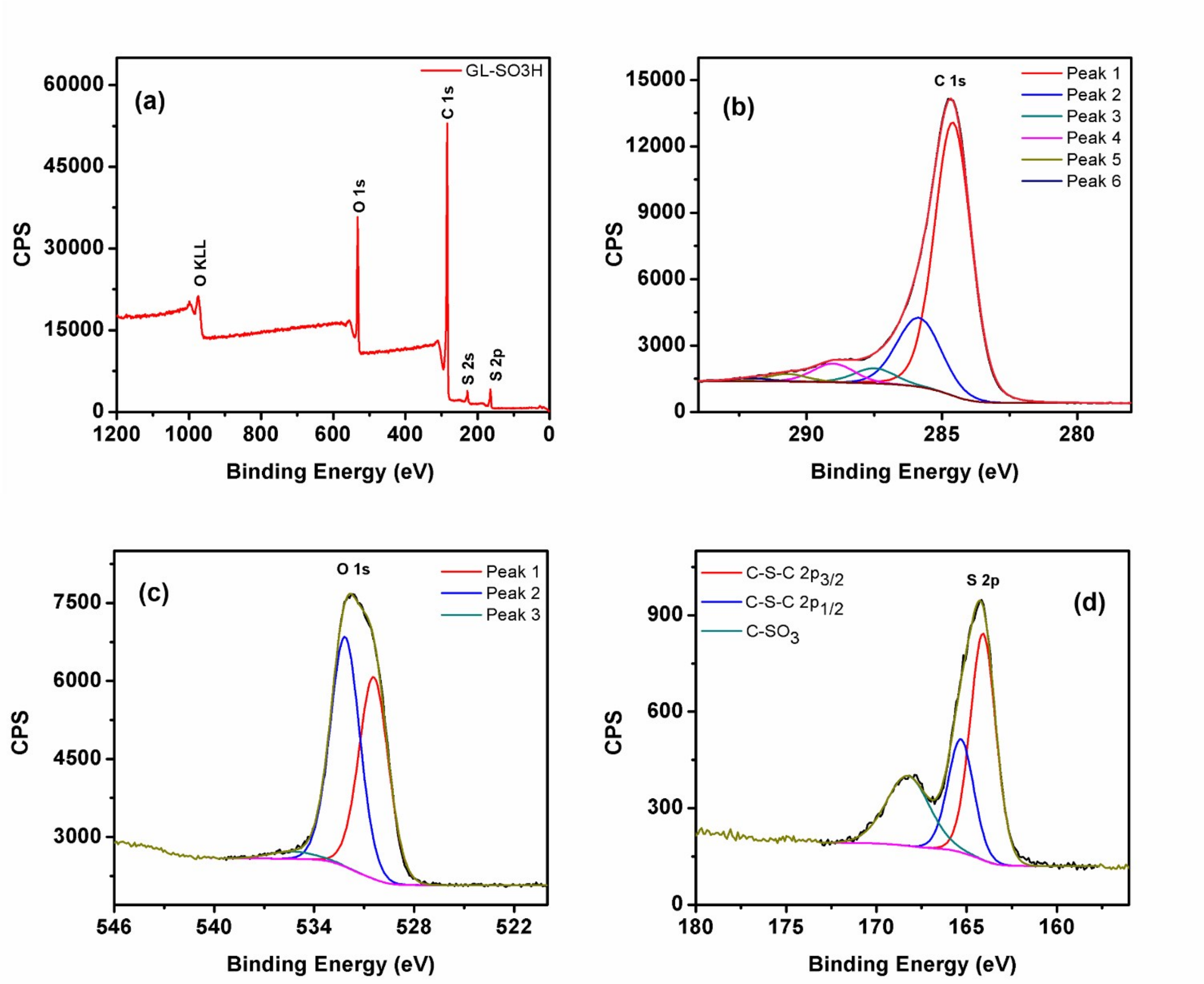


Figure S3. XPS survey spectrum (a) and core-level spectra of C 1s (b), O 1s (c), and S 2p (d) for GL-SO3H catalyst.

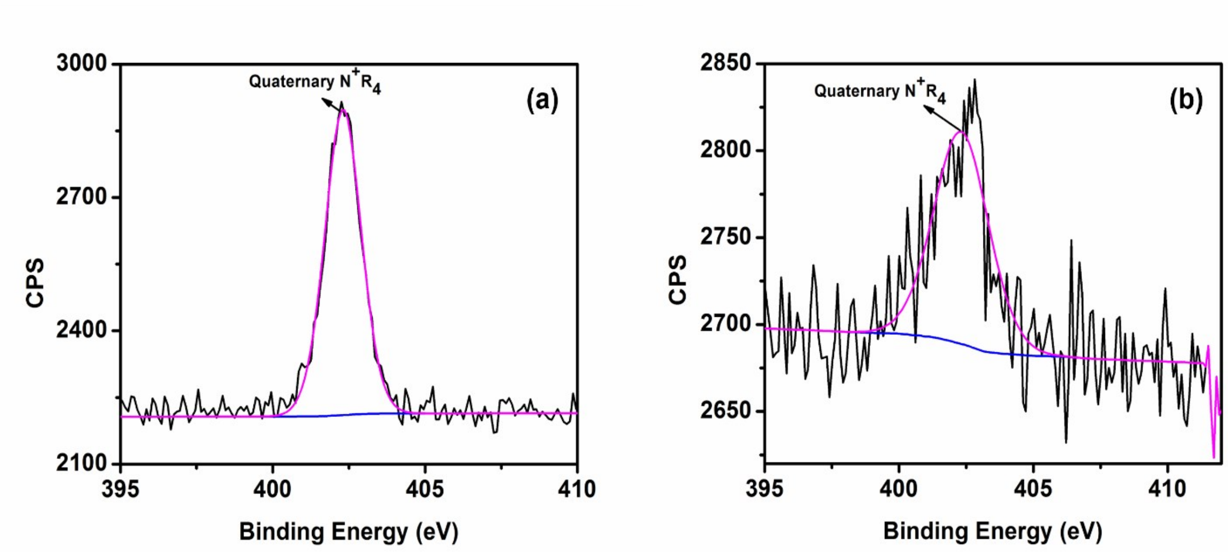


Figure S4. XPS core-level N (1s) spectra of GS-SO3H (a) and GSR-SO3H (b) catalysts.

Table S1. CHNS/O analysis (mass %) of the catalysts

Catalyst	N (%)	C (%)	H (%)	S (%)	O (%)
G-SO3H	0.0	67.0	3.7	6.1	23.3
GL-SO3H	0.0	65.1	3.7	7.4	19.3
GS-SO3H	1.2	64.1	6.1	6.7	17.3

Table S2. Atomic concentration of the elements from the high-resolution core-level spectra.

Catalyst	N (%)	C (%)	S (%)	O (%)
G-SO3H	-	79.1	4.2	16.7
GL-SO3H	-	79.2	2.4	18.4
GS-SO3H	1.6	79.8	2.3	16.3
GSR-SO3H	0.4	76.8	4.6	18.2

Section S3: Effect of different reaction parameters

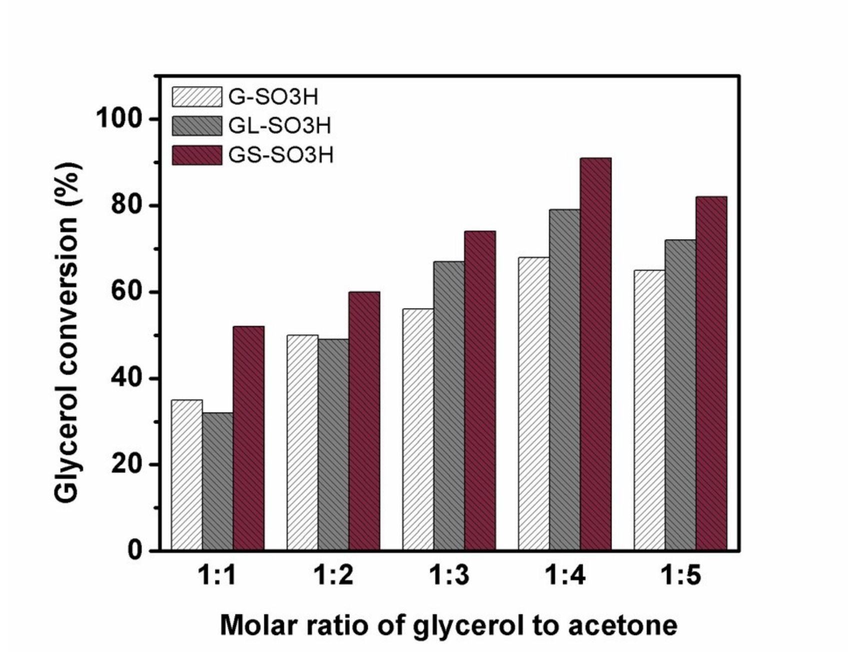


Figure S5. Acetalization of glycerol under various glycerol to acetone mole ratio over different carbon-based catalysts. Reaction condition: Room temperature, reaction time: 4 h, catalyst amount= 5 wt. % (w.r.t glycerol)

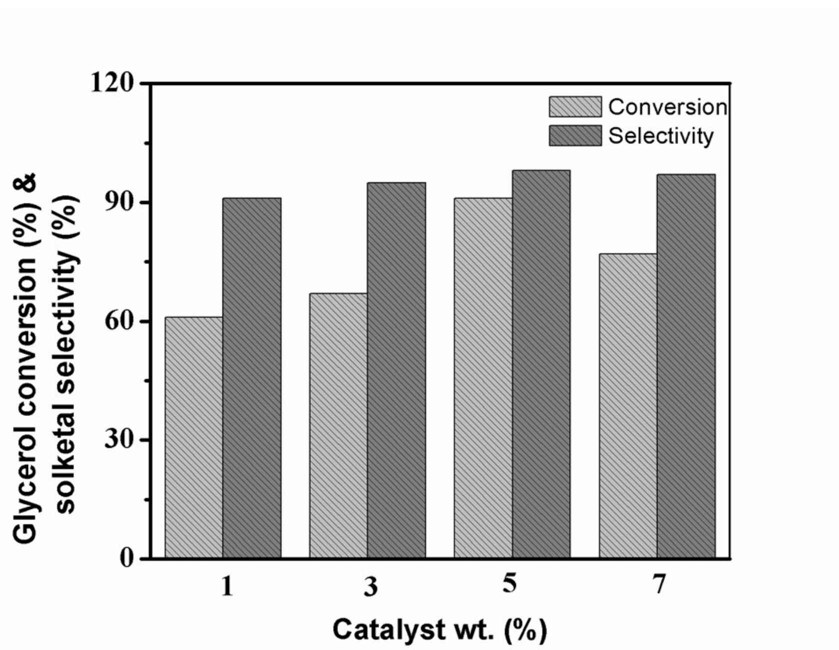
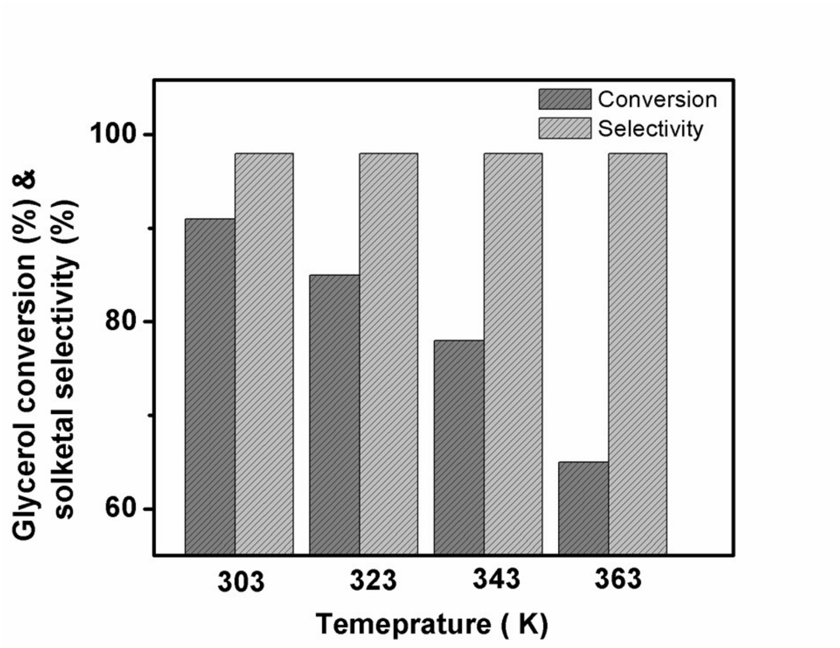


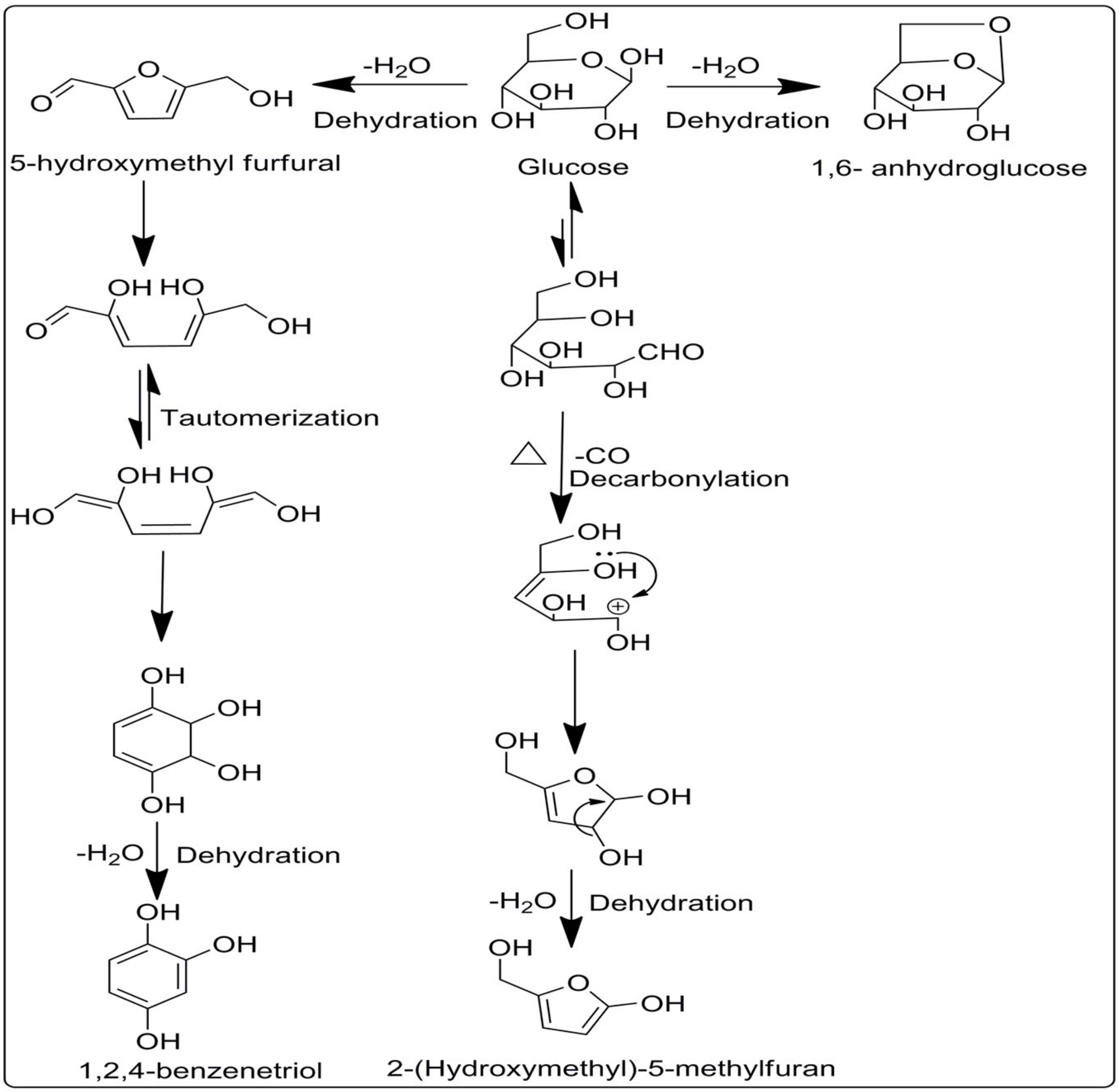
Figure S6. Variation of catalyst wt. (%) for glycerol acetalization over GS-SO3H catalyst.



Reaction condition: glycerol: acetone =1:4, room temperature, reaction time = 4 h.

Figure S7. Variation reaction temperature for glycerol acetalization over GS-SO3H catalyst. Reaction condition: glycerol: acetone =1:4, room temperature, reaction time = 4 h, catalyst amount= 5 wt. % (w.r.t glycerol).

Section S4: Macromolecules formation mechanism



Scheme S1. Dehydration, decarbonylation, and aromatization of glucose under hydrothermal condition.

Section S5: Characterization of GSR-SO3H (used) catalyst

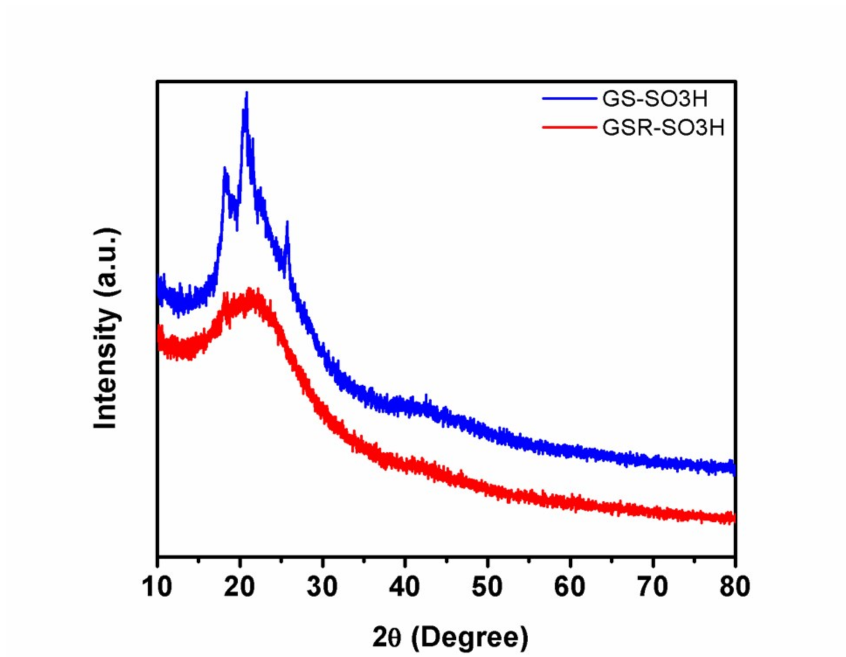


Figure S8. XRD analysis of GS-SO3H and GSR-SO3H catalysts.

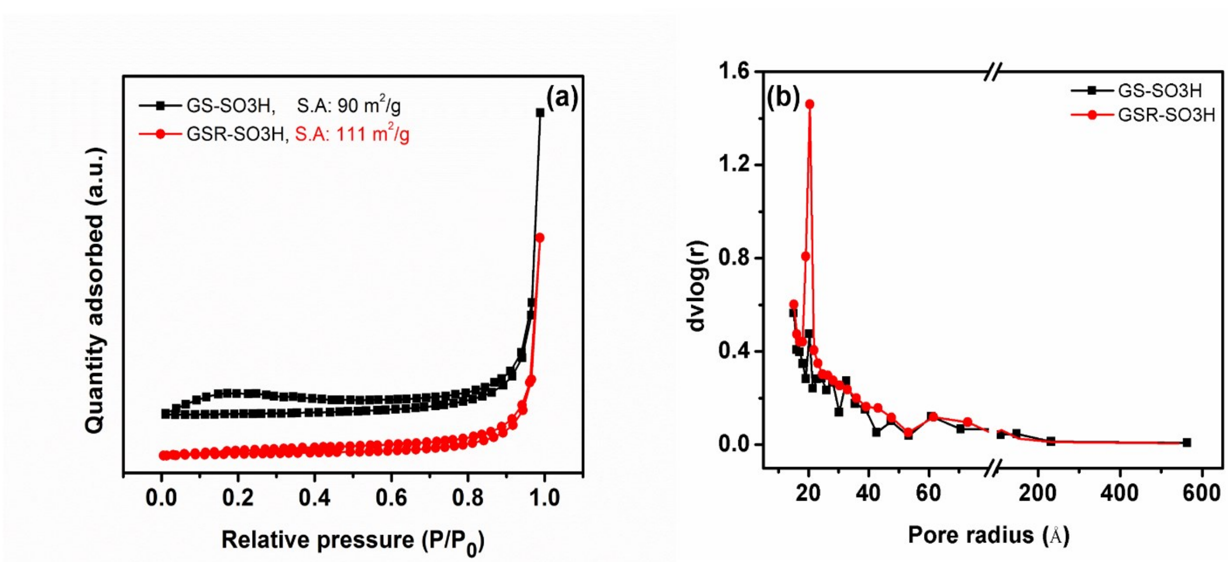


Figure S9. N_2 adsorption/desorption analysis (a) and BJH pore size distribution plot (b) of GS-SO3H and GSR-SO3H catalysts.

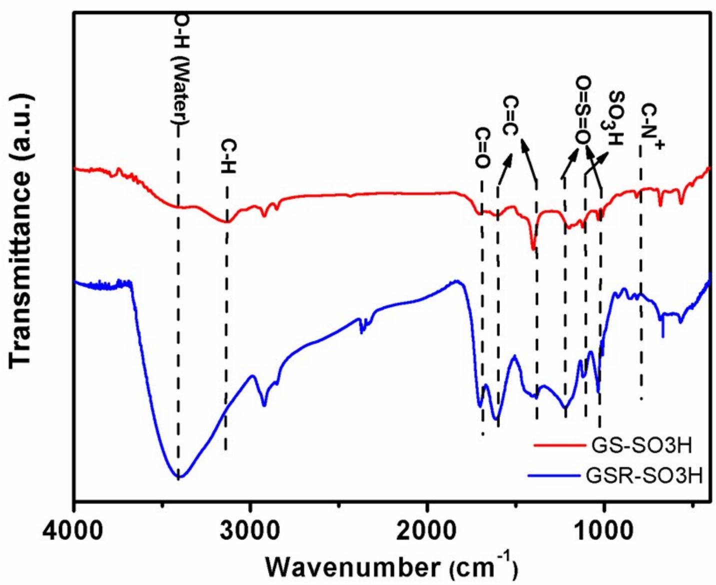


Figure S10. FTIR spectra of GS-SO3H and GSR -SO3H catalysis.

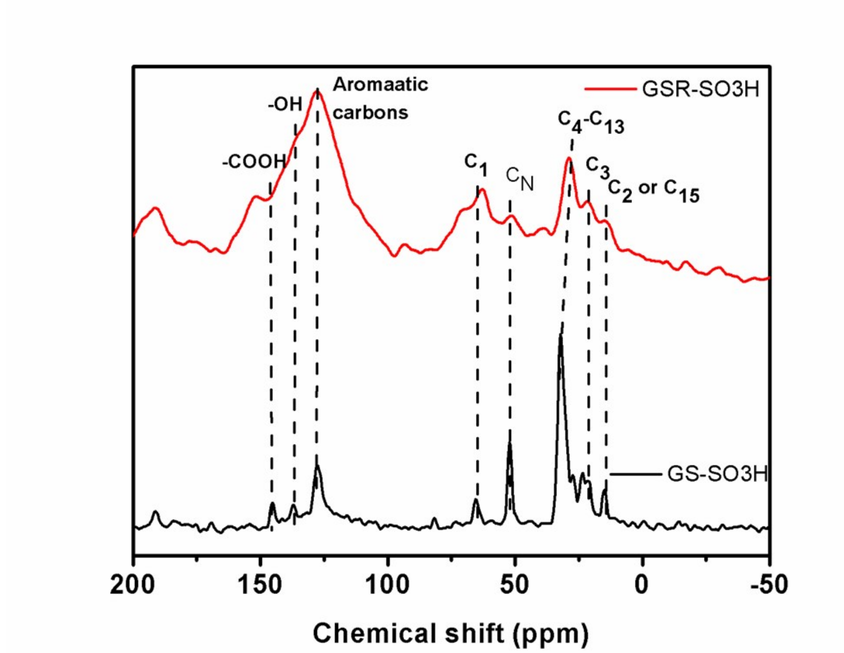


Figure S11. CP MAS ^{13}C-NMR spectra of GS-SO3H and GSR-SO3H catalysts.

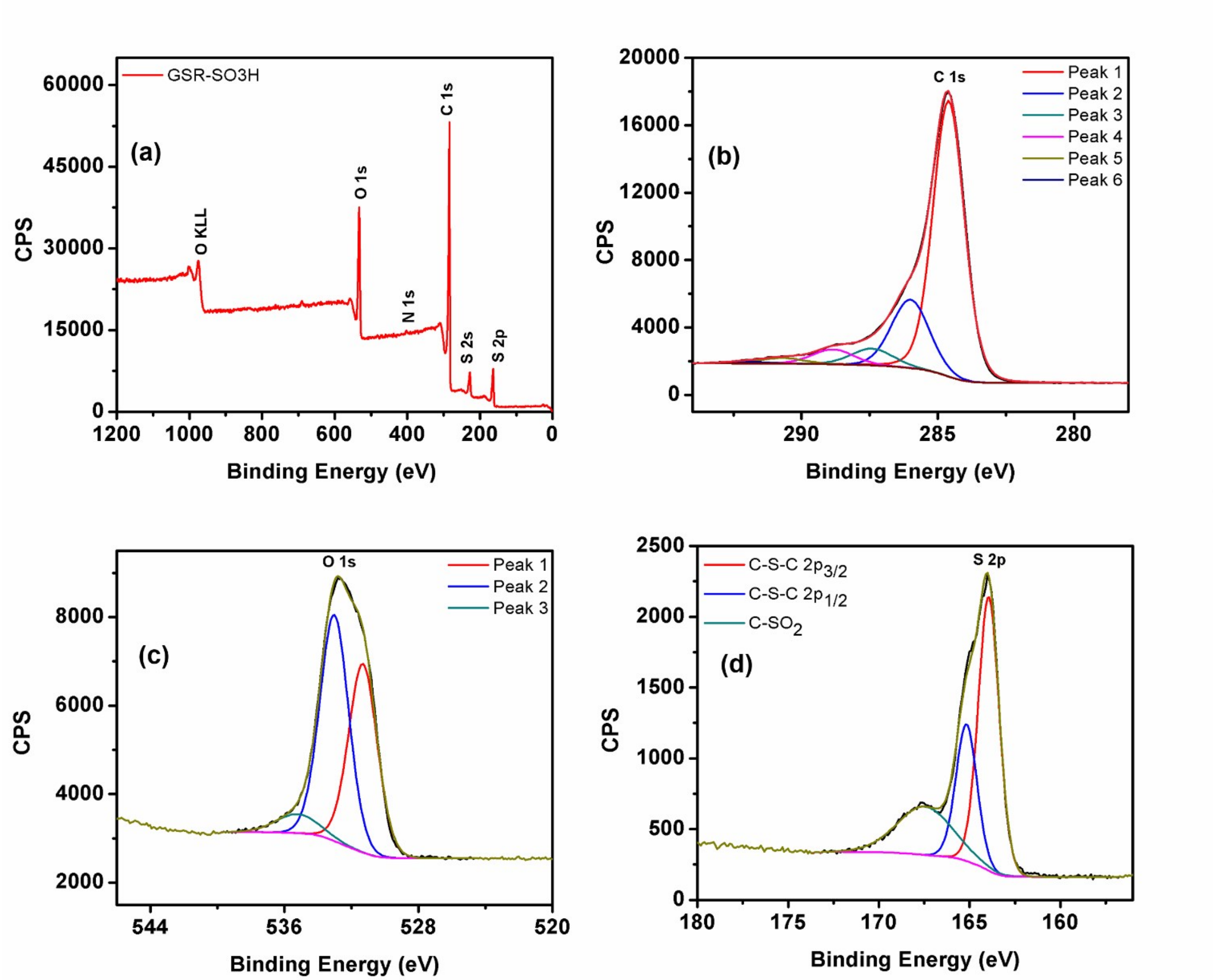


Figure S12. XPS survey spectrum (a) and core-level spectra of C 1s (b), O 1s (c), and S 2p (d) for GSR-SO3H catalyst.

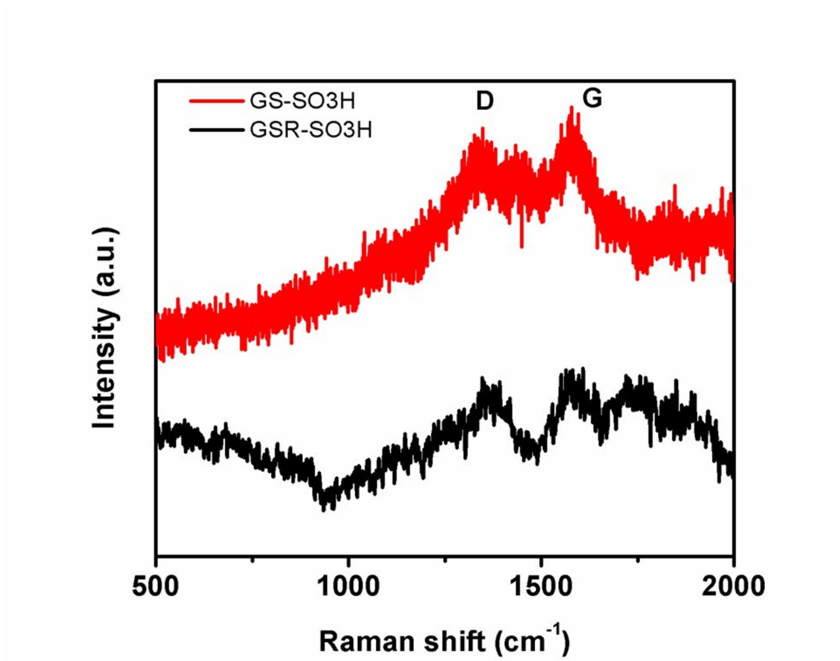


Figure S13. Raman spectra of GS-SO3H and GSR -SO3H catalysis.

Section S6: Calculation of atomic percentage to mmol g^{-1}

Atomic % of S = the total number of S atoms out of 100

$$= \frac{total\ number\ of\ S\ atoms}{N_A}\ moles\ per\ 100\ atom$$

These 100 atoms now contain carbon, oxygen, sulfur, and nitrogen

$$Total\ weight = \frac{(total\ number\ of\ C\ atoms\ \times M_C) + (total\ number\ of\ O\ atoms\ \times M_O) + (total\ number\ of\ S\ atoms\ \times M_S) + (total\ number\ of\ N\ atoms\ \times M_N)}{N_A}\ g$$

$$S\ content = \frac{total\ number\ of\ S\ atoms}{Total\ weight\ \times N_A}\ mmol\ g^{-1}$$