

Supporting informations for

$V_xO_y@C$ catalyst prepared from biomass for hydroxylation of benzene to phenol with molecular oxygen

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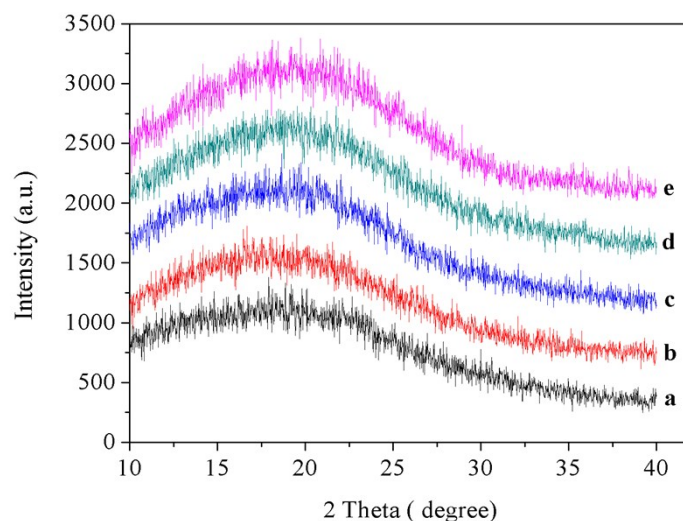


Fig.S1 XRD spectra of (a) $V_xO_y@C-S$, (b) $V_xO_y@C-G$, (c) $V_xO_y@C-F$, (d) $V_xO_y@C-(F+G)$, (e) $V_xO_y@C-Vc$.

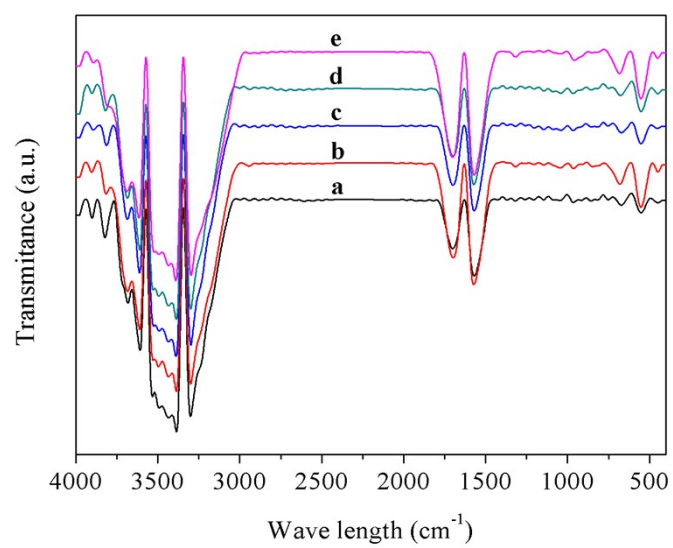


Fig. S2 FT-IR spectra of the catalysts. (a) $V_xO_y@C-S$, (b) $V_xO_y@C-G$, (c) $V_xO_y@C-F$, (d) $V_xO_y@C-(F+G)$, (e) $V_xO_y@C-Vc$.

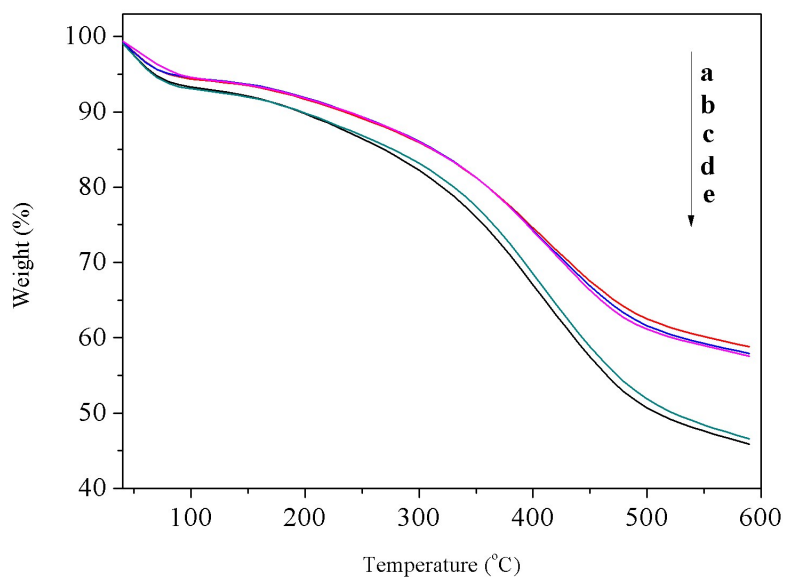


Fig. S3 TGA curves of the catalysts. (a) V_xO_y@C-G, (b) V_xO_y@C-F, (c) V_xO_y@C-Vc, (d) V_xO_y@C-(F+G), (e) V_xO_y@C-S.

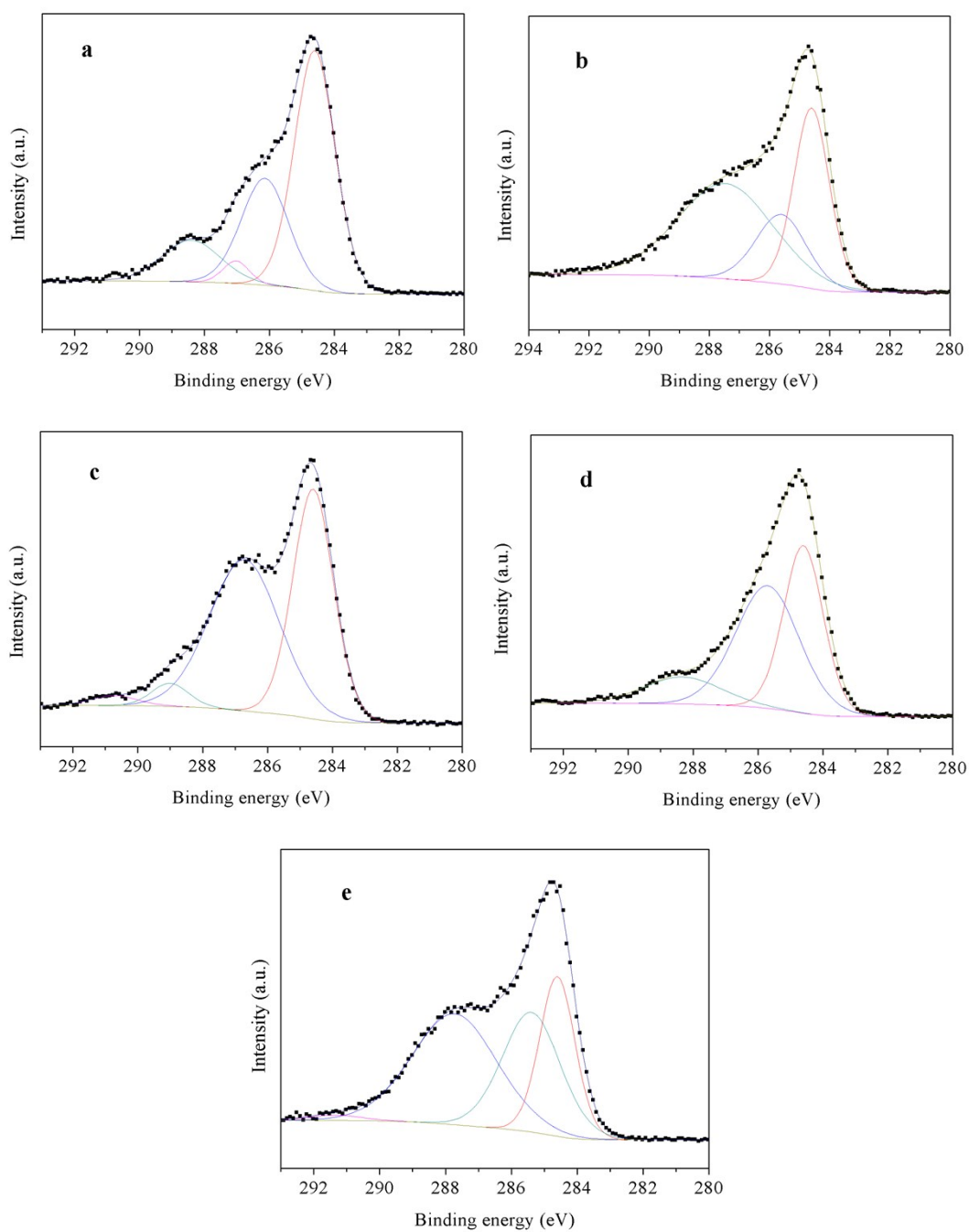


Fig. S4 C1s spectra of catalysts. (a) $V_xO_y@C-S$, (b) $V_xO_y@C-G$, (c) $V_xO_y@C-F$, (d) $V_xO_y@C-(F+G)$, (e) $V_xO_y@C-Vc$.

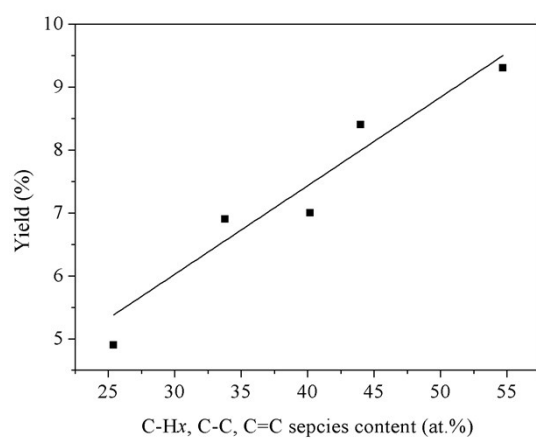


Fig. S5 The relationship between C1 species (C-H_x, C-C, C=C) and yield of phenol.

Table S1 Summary of XPS V2p data of catalysts.

Entry	Catalysts	V ⁵⁺	V ⁴⁺	V ³⁺
1	V _x O _y @C-S	517.40eV 7.76%	516.30eV 25.63%	515.32eV 66.61%
2	V _x O _y @C-G	—	517.14eV 13.36%	515.06eV 86.64%
3	V _x O _y @C-F	518.07eV 15.78%	—	515.74eV 84.22%
4	V _x O _y @C-(F+G)	517.47eV 32.59%	516.02eV 43.25%	514.43eV 24.45%
5	V _x O _y @C-Vc	—	516.96eV 58.93%	514.95eV 41.07%