Electronic Supplementary Information

Ordered Mesoporous V_2O_5–WO_3 Composite Catalysts for Efficient Oxidation of Aryl Alcohols

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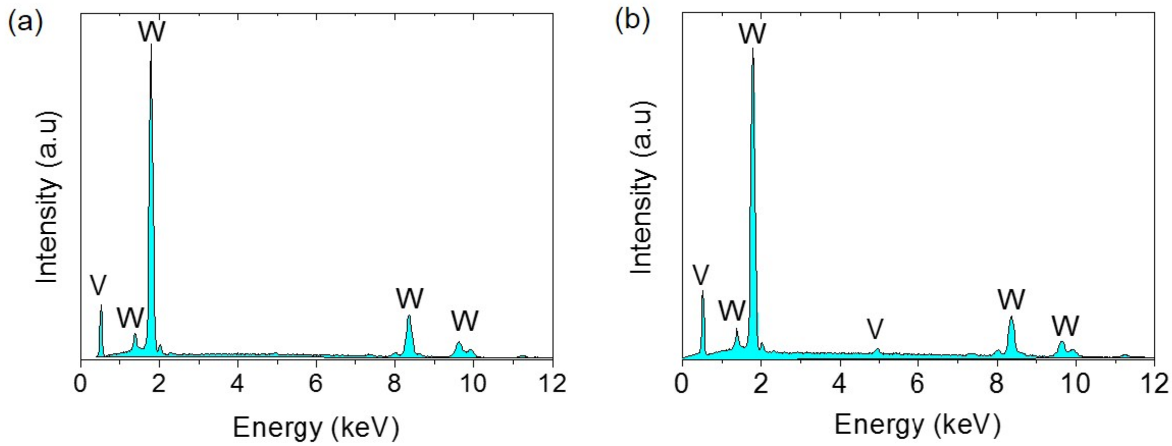

Fig. S1 Typical EDS spectra of mesoporous WO_3 materials containing (a) 1% and (b) 4% V_2O_5. The EDS spectra show an average atomic ratio W/V of ~97.5:2.5 and ~90.9:9.1 that corresponds to a ~1 wt % and ~3.8 wt % V_2O_5 loading for 1% V_2O_5/WO_3 and 4% V_2O_5/WO_3 composites, respectively.

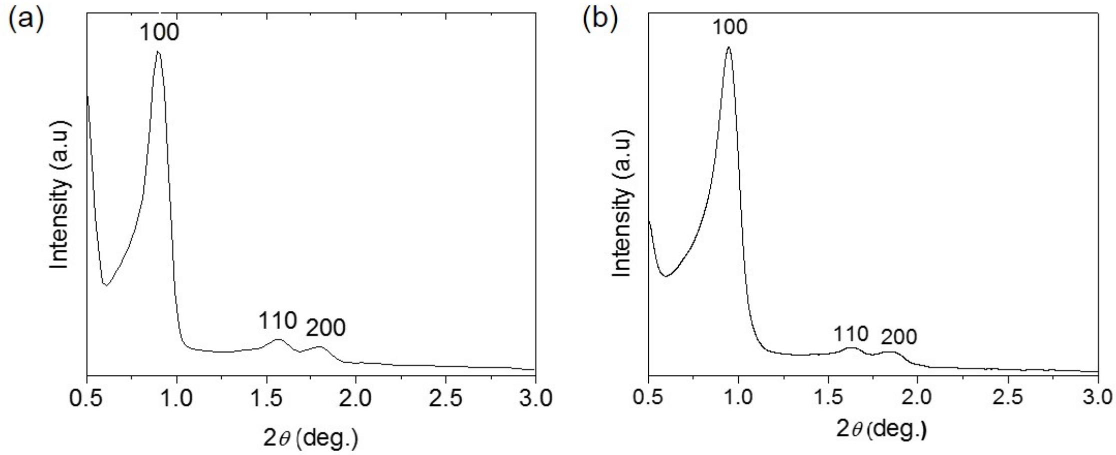

Fig. S2 Low-angle XRD patterns of mesoporous (a) SBA-15 and (b) APS/SBA-15 materials. The indexing of the Bragg diffractions is consisted with a hexagonal *p6mm* unit cell with lattice parameter a_o ~11.1 nm for SBA-15 and ~10.7 nm for APS/SBA-15.

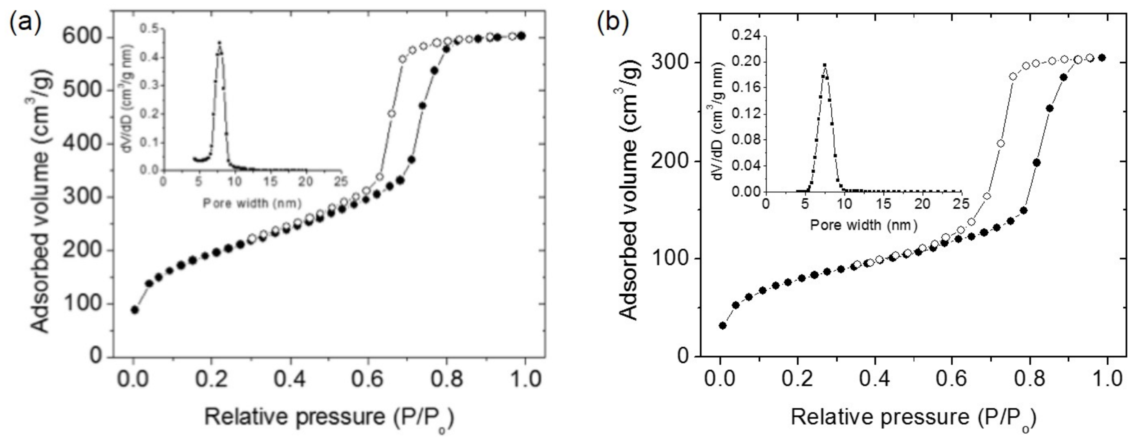

Fig. S3 Nitrogen adsorption–desorption isotherms and the corresponding NLDFT pore size distribution (inset) for mesoporous (a) SBA-15 and (b) NH_2-functionalized SBA-15 (APS/SBA-15) materials. The SBA-15 shows specific surface area of 676 m^2g^{-1}, total pore volume of 0.96 cm^3g^{-1} and narrow pore size distribution with pore width of 7.8 nm. The APS/SBA-15 shows specific surface area of 286 m^2g^{-1}, total pore volume of 0.96 cm^3g^{-1} and narrow distribution of pore size with pore width of 7.4 nm. The pore wall thickness of modified silica (APS/SBA-15), estimated by the equation $WT=a_o-D_p$, is about 3.3 nm.

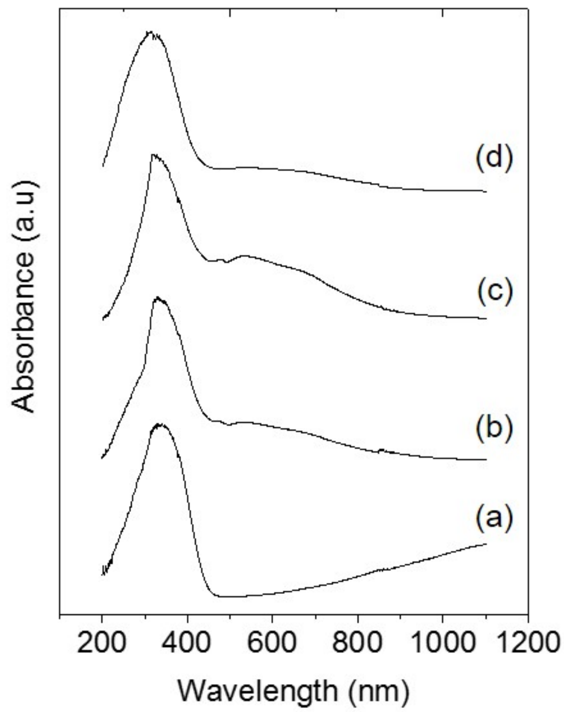

Fig. S4 Diffuse reflectance ultraviolet-visible (UV-vis) spectra of mesoporous (a) *meso*-WO_3 and (b) 1% V_2O_5/WO_3, (c) 4% V_2O_5/WO_3 and (d) 6% V_2O_5/WO_3 composite materials.

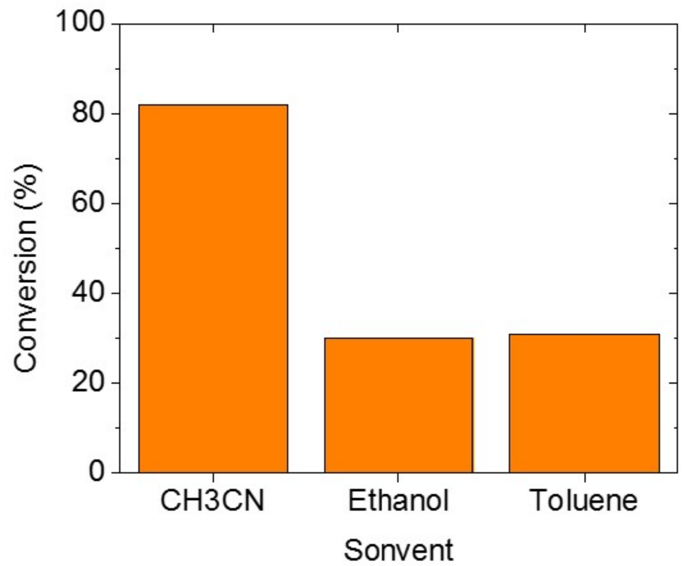

Fig. S5 Oxidation of 1-phenylethanol with 4% V_2O_5/WO_3 catalyst in different solvents. *Reaction conditions*: 0.1 mmol 1-phenylethanol, 50 mg catalyst, 40 equiv. *t*-BuOOH, 2 mL solvent, 50 ^oC, 4 h.

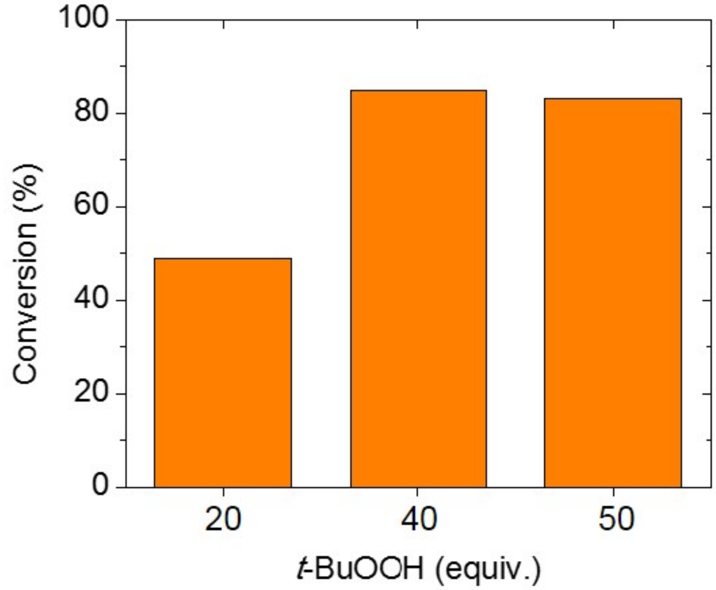

Fig. S6 Oxidation of 1-phenylethanol with 4% V_2O_5/WO_3 catalyst, using various equivalents of *t*-BuOOH oxidant. *Reaction conditions*: 0.1 mmol 1-phenylethanol, 50 mg catalyst, 2 mL CH_3CN, 50 °C, 2 h.

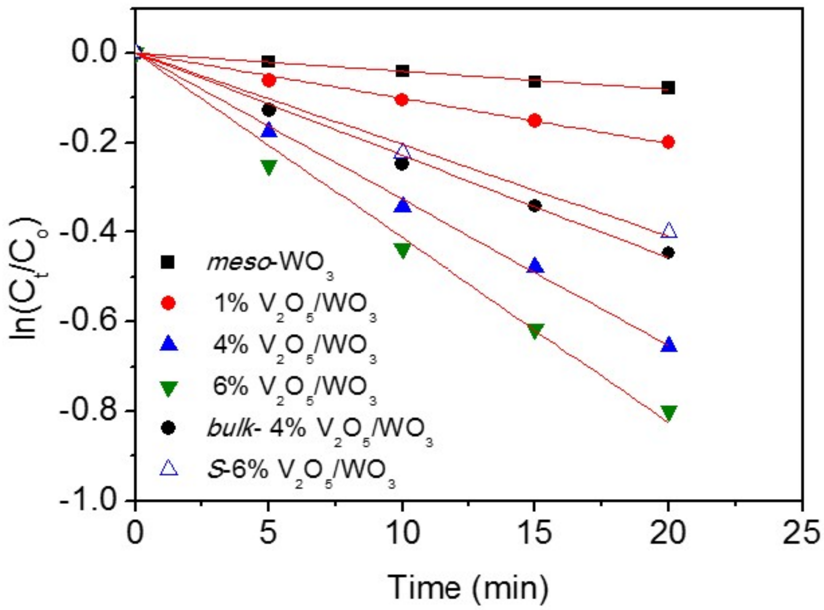

Fig. S7 Kinetic profiles (where C_o and C_t are the concentrations of 1-phenylethanol at the initial state of reaction and at the time *t*, respectively) of the oxidation of 1-phenylethanol catalyzed by mesoporous *meso*-WO_3, *x*% V_2O_5/WO_3 (*x*= 1, 4 and 6) and *S*-4% V_2O_5/WO_3 materials and macroscopic *bulk*-4% V_2O_5/WO_3 solid.

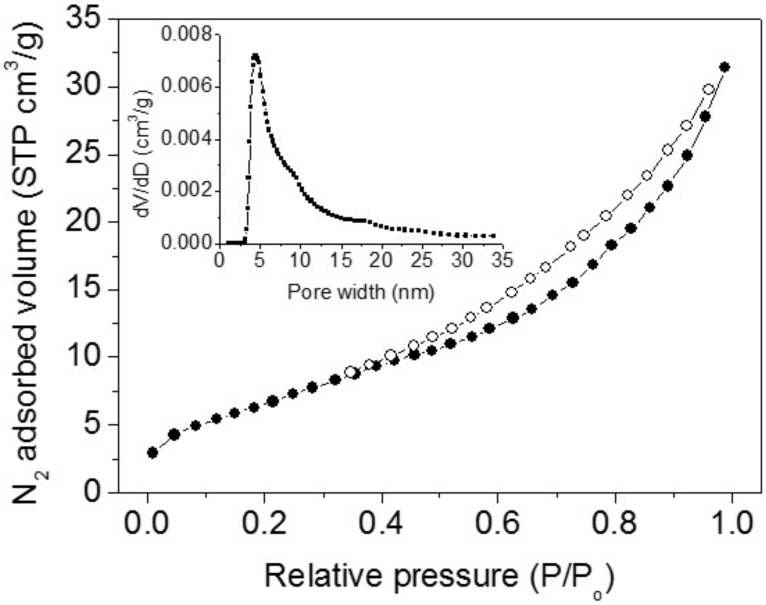

Fig. S8 Nitrogen adsorption–desorption isotherms at 77K of reused 4% V_2O_5/WO_3 catalyst. Analysis of the adsorption data with the BET method gives surface area of 26 m^2g^{-1} and total pore volume of 0.05 cm^3g^{-1}. Inset: the corresponding NLDFT pore size distribution, indicating pore size of ~4.5 nm

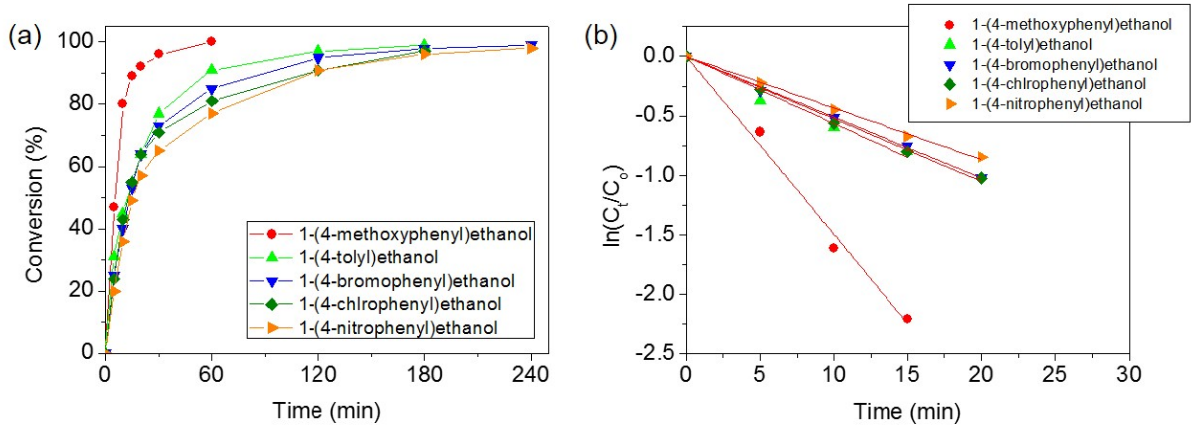

Fig. S9 (a) Time evolution and (b) kinetic profiles (where C_o and C_t are the concentrations of substrate at the initial state of reaction and at the time *t*, respective) of the oxidation of various *para*-substituted benzyl alcohols catalyzed by mesoporous 4% V_2O_5/WO_3 catalyst. In panel b the corresponding red lines are fit to the data. *Reaction conditions*: 0.1 mmol substrate, 50 mg catalyst, 40 equiv. *t*-BuOOH, 2 mL CH_3CN, 50 ^oC.