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Electronic Supplementary Information

pH-controlled assembly of three-dimensional tungsten oxide hierarchical nanostructures for catalytic oxidation of cyclohexene to adipic acid

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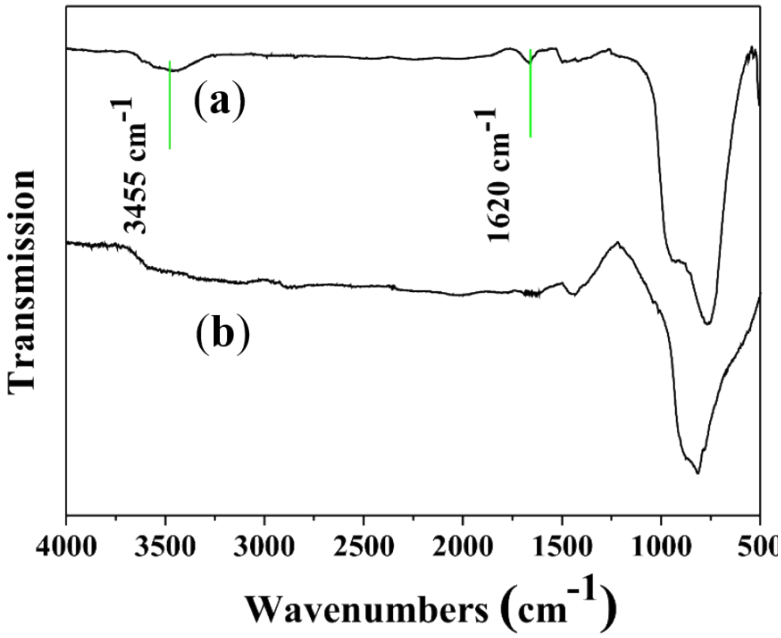

Fig. S1 FTIR spectra of the as-prepared (a) o-$WO_3 \cdot 0.33H_2O$ and (b) h-WO_3.

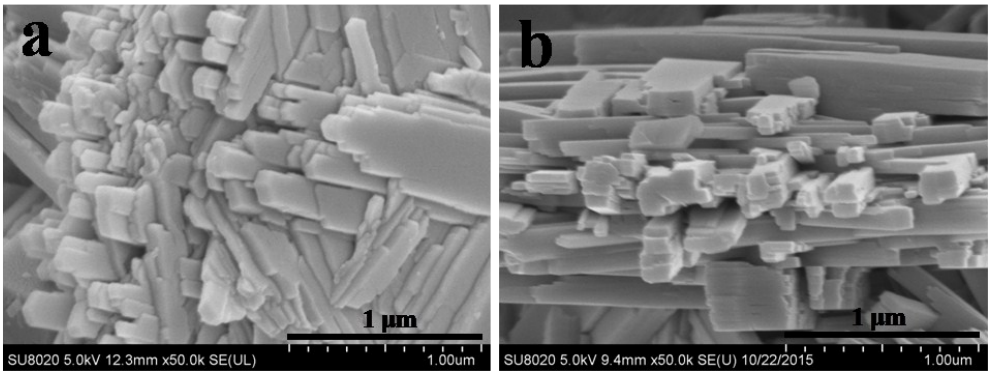

Fig. S2 FESEM images of the synthesized WO_3-2.0.

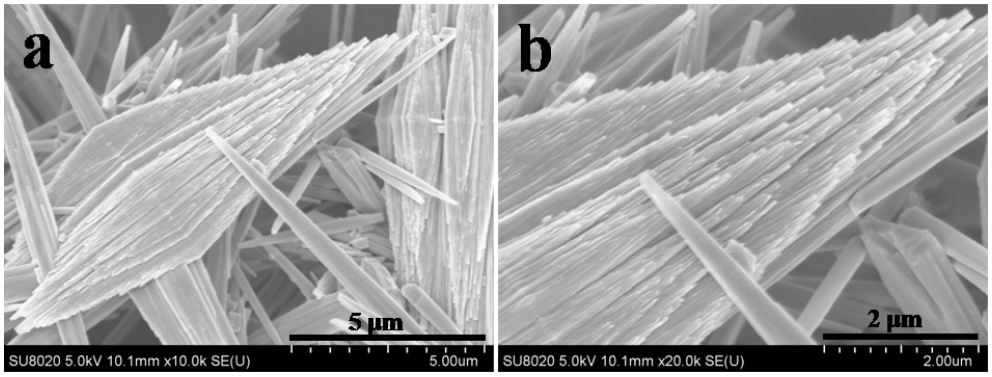

Fig. S3 FESEM images of the as-prepared WO_3-2.5.

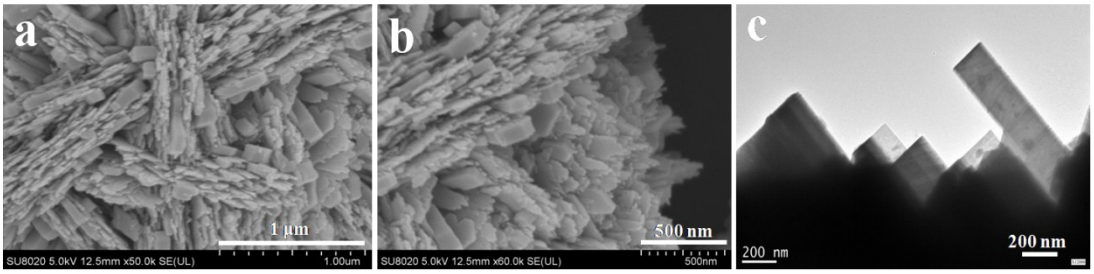

Fig. S4 (a, b) FESEM images and (c) TEM image of the as-prepared WO_3-1.0.

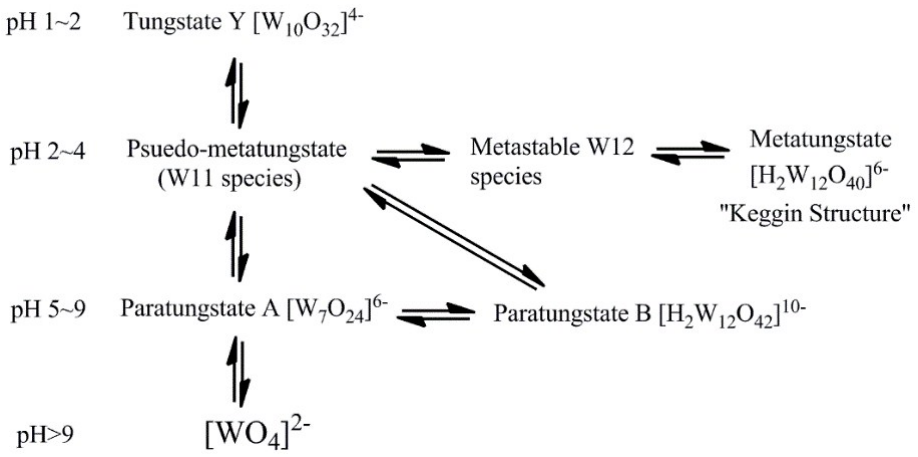

Fig. S5 Reaction scheme for the condensation of tungstate ions in aqueous solutions.

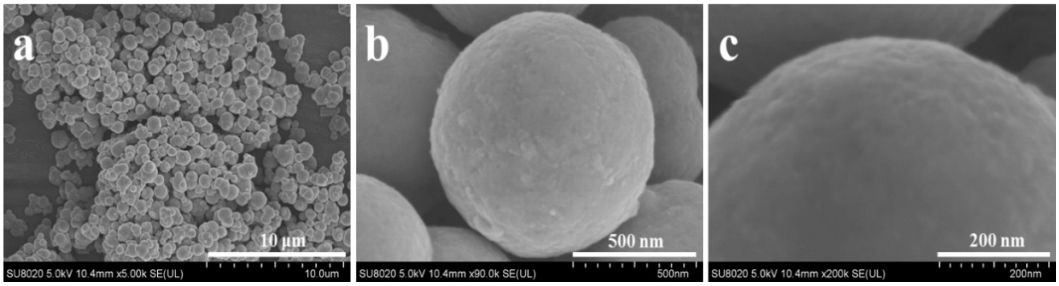

Fig. S6 As-synthesized products prepared at 30 min with the final pH of the mixed solution is 1.0.

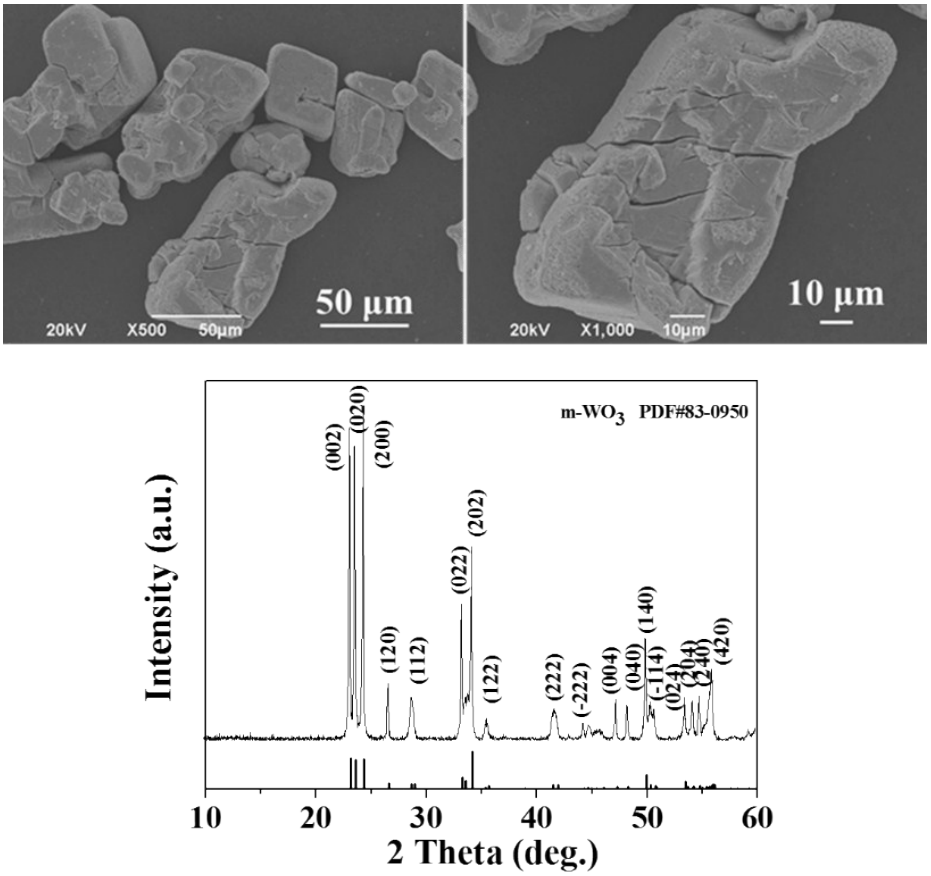

Fig. S7 The SEM images and XRD pattern of the commercial WO_3.

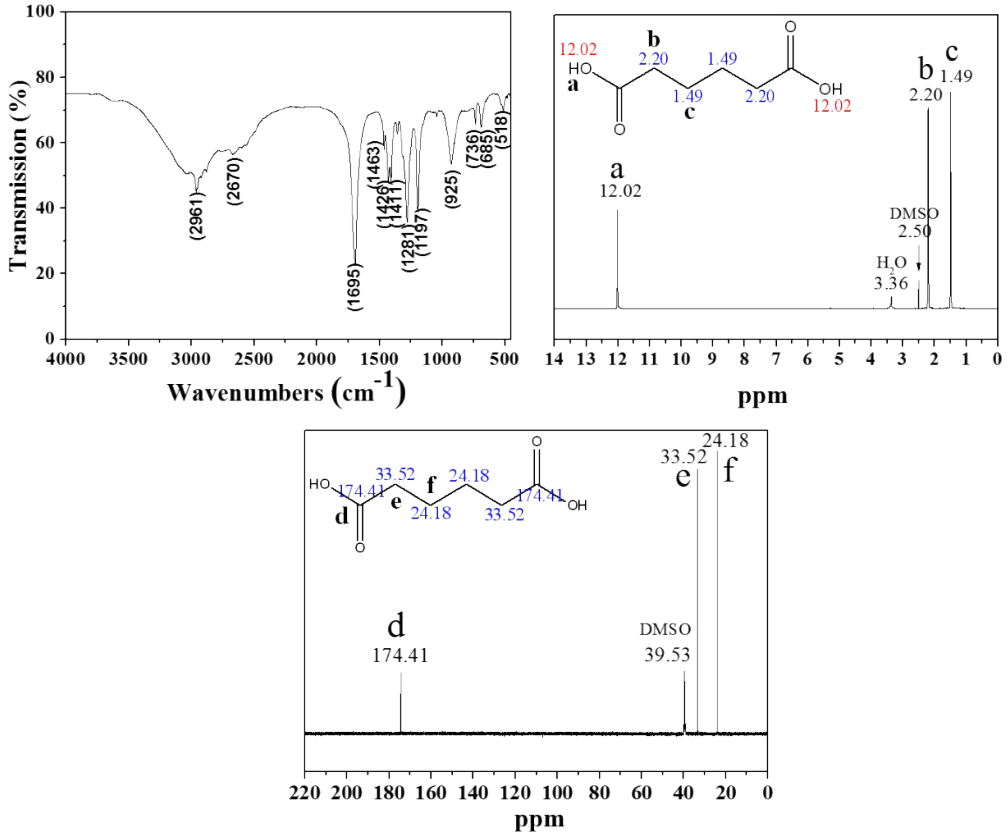

Fig. S8 (a) FTIR, (b) ^{1}H NMR and (c) ^{13}C NMR spectra of the synthesized adipic acid. 1695 cm^{-1}∼ν(C=O); 2500–3300 cm^{-1}∼overlap of ν(CH_2) and ν(O-H); 1426 cm^{-1}, 1411 cm^{-1}, 1281 cm^{-1}, 1197 cm^{-1}∼overlap of ν(C-O), δ(O-H) and δ(CH_2). **a** (12.02 ppm, –COO**H**); **b** (2.20 ppm, –C**H$_2$**–COOH); **c** (1.49 ppm, –C**H$_2$**–CH_2–COOH). **d** (174.41 ppm, –**C**OOH); **e** (33.52 ppm, –**C**H_2–COOH); **f** (24.18 ppm, –**C**H_2–CH_2–COOH).

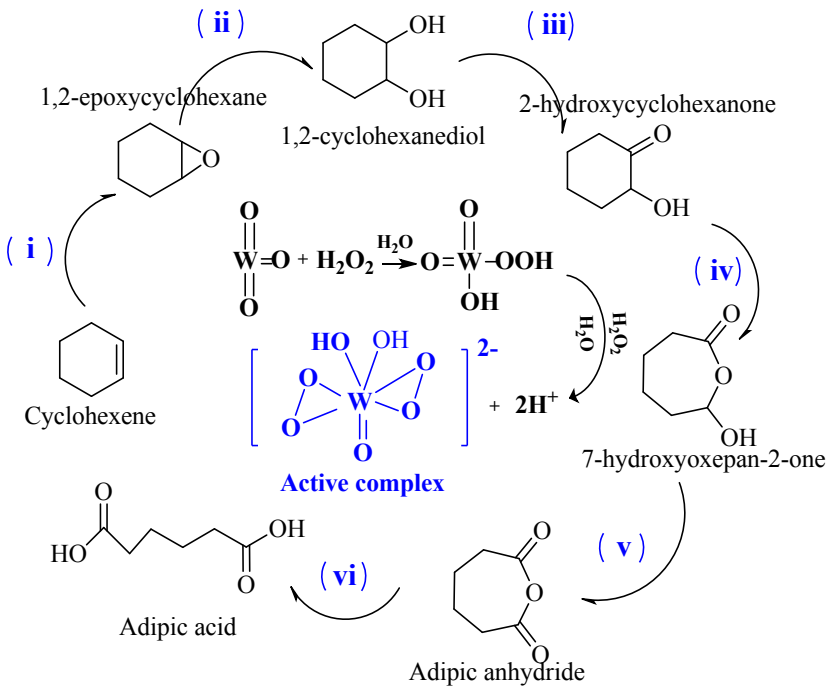

Fig. S9 Plausible pathway for the catalytic oxidation of cyclohexene to adipic acid.