Facile Synthesis of Novel MnO$_x$ Nano-structures and Their Catalytic Performance on CO Oxidation

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**Fig. S1** N$_2$ adsorption-desorption isotherms of the Mn$_3$O$_4$ nanomaterials (S1) after calcination method; inset is the corresponding BJH pore size distribution curve.

**Fig. S2** N$_2$ adsorption-desorption isotherms of the Mn$_3$O$_4$ nano-ellipsoids (S2) after calcination method; inset is the corresponding BJH pore size distribution curve.
**Fig. S3**  N$_2$ adsorption-desorption isotherms of the Mn$_2$O$_3$ nano-flowers (S3) after calcination method; inset is the corresponding BJH pore size distribution curve.

**Fig. S4**  Typical TEM images of Mn$_2$O$_3$ nano-octahedrons (S4).

**Sample (Mn$_2$O$_3$ nano-octahedrons) preparation.** All chemicals were of analytical grade and were used as-received without further purification. Monodispersed octahedral Mn$_2$O$_3$ nanoparticles were synthesized through a facile solvothermal route in the presence of PVP. In a typical experiment, 800 μl of Mn(NO$_3$)$_2$ solution (50 wt.%; 3.5 mmol) and 0.8 g of PVP (K-30) were dissolved in 18 ml of DMF under vigorous stirring. The solution was then turned into a Teflon-lined stainless steel autoclave of capacity 25 ml. The sealed tank was put into an oven and heated at 180°C for 24 h. After reaction, the autoclave was cooled to room temperature naturally. The black precipitates were collected by centrifugation, washed with deionized water and ethanol several times, and finally dried in air at 80°C for 12 h. The parameters affecting the morphology of the synthesized Mn$_2$O$_3$ nanostructures were also investigated under different experimental conditions.
**Fig. S5** HRTEM image of the Mn$_2$O$_3$ nano-octahedrons

**Fig. S6** Typical TEM images of Mn$_3$O$_4$ nano-ellipsoids (S2) after the catalysis.

**Fig. S7** Typical TEM images of Mn$_2$O$_3$ nano-flowers (S3) after the catalysis.