Supporting information

Reversible pH switchable oxidase-like activities of MnO\textsubscript{2} nanosheets for visual molecular majority logic gate

Mengxin Zhao\textsuperscript{a}, Yang Tao\textsuperscript{b}, Wei Huang\textsuperscript{a}, Yi He\textsuperscript{a}\textsuperscript{*}

\textsuperscript{a} School of National Defence Science & Technology, Southwest University of Science and Technology, Mianyang, 621010, P. R. China.

\textsuperscript{b} High Speed Aerodynamics Institute, China Aerodynamic Research and Development Center, Mianyang, 621000, P. R. China.

*Corresponding author: Dr. Yi He, Tel: +86-816-6089885, Fax: +86-816-6089889, Email: yhe2014@126.com.
Preparation of MnO$_2$ nanosheets

Briefly, 20 mL mixture solution consisting of 3.0 wt% H$_2$O$_2$ and 0.6 M tetramethylammonium hydroxide was added to a flask (50 mL), followed by addition of 10 mL of 0.3 M MnCl$_2$ solution at room temperature (~25 °C). The resulting mixture solutions were stirred vigorously overnight. After that, the resulting dispersion was centrifuged twice, and washed with water and ethanol. Finally, the black MnO$_2$ nanosheet precipitates are dispersed in DI water under ultrasonication.
Fig. S1. UV-vis absorption spectrum of MnO$_2$ nanosheet dispersion.
Fig. S2. (a) Successive UV-vis absorption spectra of TMB oxidation induced by the oxidase-like activity of MnO₂ nanosheets at pH 6. (b) Plot of \( \ln \left( \frac{A}{A_0} \right) \) versus reaction time.

The kinetic equation for the oxidation reaction of TMB can be written as:

\[
dC/dt = k_{\text{app}} C_t \quad \text{or} \quad \ln \left( \frac{C_t}{C_0} \right) \quad \text{or} \quad \ln \left( \frac{A_t}{A_0} \right) = k_{\text{app}}
\]

where \( C_t \) is the concentration of oxTMB at time \( t \), \( A_t \) is the absorbance located at 652 nm at time \( t \), \( k_{\text{app}} \) is the apparent rate constant.
Fig. S3. UV-vis absorption spectra of the chromogenic reaction of TMB induced by oxidase-like activities of MnO$_2$ nanosheets in the presence of ascorbic acid with different concentrations under acidic medium (pH 6.5).
Fig. S4. Chemiluminescence kinetic curve of MnO$_2$ nanosheet-luminol system with different concentrations of luminol.
Fig. S5. Effect of the pH value on the UV-vis absorption spectra of the chromogenic reaction of TMB induced by oxidase-like activities of MnO$_2$ nanosheets.
**Fig. S6.** UV-vis absorption spectra of OR-INH cascade logic circuit in the presence of different inputs: I) DI water, II) H₂O₂ solution, III) MnO₂ nanosheet dispersion, IV) H₂O₂ solution and MnO₂ nanosheet dispersion, V) NaOH solution, VI) H₂O₂ and NaOH solutions, VII) MnO₂ nanosheet dispersion and H₂O₂ solution, and VIII) MnO₂ nanosheet dispersion, and the mixture of H₂O₂ and NaOH solutions.