## Supporting Information

## Immobilization of iron hydroxide/oxide on reduced graphene oxide: peroxidase-like

## activity and selective detection of sulfide ions

Kuang-I Hsu,<sup>*a*</sup> Chia-Wen Lien,<sup>*b*</sup> Chia-Hua Lin,<sup>*c*</sup> Huan-Tsung Chang,<sup>\**b*</sup> and Chih-Ching Huang<sup>\*ade</sup> <sup>*a*</sup>Institute of Bioscience and Biotechnology, National Taiwan Ocean University, 2, Pei-Ning Road, Keelung, 20224, Taiwan. E-mail: huanging@ntou.edu.tw; Tel.: +886-2-24622192 ext. 5517; Fax: +886-2-24622034

<sup>b</sup>Department of Chemistry, National Taiwan University, 1, Section 4, Roosevelt Road, Taipei 10617, Taiwan. E-mail: changht@ntu.edu.tw; Tel. and Fax: +886-2-33661171

<sup>c</sup>Key Laboratory for Nano-Bio Interface Research, Suzhou Key Laboratory for Nanotheranostics, Division of Nanobiomedicine, Suzhou Institute of Nano-Tech and Nano-Bionics, Chinese Academy of Sciences, Suzhou 215123, China.

<sup>d</sup>Center of Excellence for Marine Bioenvironment and Biotechnology (CMBB), National Taiwan Ocean University, 2, Pei-Ning Road, Keelung, 20224, Taiwan

<sup>e</sup>School of Pharmacy, College of Pharmacy, Kaohsiung Medical University, 100, Shih-Chuan 1st Road, Kaohsiung 80708, Taiwan



Fig. S1 Raman spectra of as-prepared rGO (10X) and  $FeO_xH$ -rGO nanocomposites (10X).



**Fig. S2** EDS spectrum of bare  $FeO_xH$  nanostructures.



**Fig. S3** Fe  $2p_{3/2}$  core-level photoelectron spectra of 5.0 mM Tris-borate solutions (pH 7.0) containing FeO<sub>x</sub>H-rGO nanocomposites (10X) dosed onto silicon substrates and measured at room temperature.



**Fig. S4** C 1*s* core-level photoelectron spectra of 5.0 mM Tris-borate solutions (pH 7.0) containing (A) GO (10X), (B) FeO<sub>x</sub>H-GO nanocomposites (10X), (C) rGO (10X), and (D) FeO<sub>x</sub>H-rGO nanocomposites (10X) dosed onto silicon substrates and measured at room temperature.



**Fig. S5** UV-vis absorption spectra of 5.0 mM Tris-borate (pH 7.0) containing rGO (1X) prepared by irradiation of GO with UV light (365 nm; 140 mW cm<sup>-2</sup>; 0–10 h).



**Fig. S6** Fluorescence response ( $I_{F585}$ ) of 5.0 mM Tris-borate (pH 7.0) containing AR (10  $\mu$ M) and FeO<sub>x</sub>H-rGO nanocomposites (1X) in the presence of different concentrations of H<sub>2</sub>O<sub>2</sub> (0–10  $\mu$ M) after (A) reaction for 2 h without microwave irradiation and (B) reaction for 10 min under microwave irradiation (170 W). Error bars represent the standard deviations from three repeated experiments. Other conditions were the same as those described in Fig. S4.



Fig. S7 Double-reciprocal plots of reaction rate of  $H_2O_2/AR$ –FeO<sub>x</sub>H-rGO system versus substrate concentration at a fixed concentration of one substrate versus different concentrations of the second substrate for (A)  $H_2O_2$  or (B) AR.



**Fig. S8** Tolerances of the  $H_2O_2/AR$ –FeO<sub>x</sub>H-rGO probe toward S<sup>2–</sup> ions against other anions. Fluorescence response ( $I_{F585}$ ) of 5.0 mM Tris-borate solution (pH 7.0) containing AR (10  $\mu$ M),  $H_2O_2$  (10  $\mu$ M), S<sup>2–</sup> (10  $\mu$ M), and FeO<sub>x</sub>H-rGO nanocomposites (0.1X) in the absence or presence of the other anions (100  $\mu$ M) at 585 nm.



**Fig. S9** Analyses of S<sup>2–</sup> ions in representative (A) stream water, (B) lake water, and (C) tap water, determined using  $H_2O_2/AR$ –FeO<sub>x</sub>H-rGO probes. Water samples (diluted 10-fold) were spiked with S<sup>2–</sup> ions (100 nM–1.0  $\mu$ M). Other conditions were the same as those described in Fig. 5B.