# **Supporting Information**

# CeO<sub>2-x</sub>/C/rGO nanocomposites derived from Ce-MOF and

## graphene oxide as robust platform for highly sensitive uric acid

### detection

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Fig. S1 TGA curve of Ce-MOF/GO nanocomposites measured in Air (a) and Ar (b)

atmosphere



Fig. S2 (a) XRD pattern of graphene oxide, (b) Simulated XRD pattern of Ce-MOF,(c) XRD patterns of as-prepared Ce-MOF and (d) Ce-MOF/GO nanocomposites



Fig. S3 Influence of GO concentrations on the morphology of Ce-MOF/GO nanocomposites. (a) 0.2 mg·ml<sup>-1</sup>, (b) 0.5 mg·ml<sup>-1</sup>, (c) 1.0 mg·ml<sup>-1</sup>, (d) 1.5 mg·ml<sup>-1</sup>

Fig.S3-S6 presented SEM images of Ce-MOF/GO nanocomposites fabricated under different conditions. Firstly, influence of GO concentration on the morphology of Ce-MOF/GO nanocomposites was studied as shown in Fig. S2. It was apparent that straw-sheaflike Ce-MOF exposed out of the Ce-MOF/GO nanocomposites when GO concentration was 0.2 mg·ml<sup>-1</sup>, Ce-MOF was gradually wrapped by GO nanosheets with increasing of GO concentrations. In order to obtain Ce-MOF/GO nanocomposites with uniform morphology and reduce the concentration of GO solutions, GO with concentration of 1.0 mg·ml<sup>-1</sup> was optimized and used in the following experiments. Fig. S3 and S4 exhibited SEM images of Ce-MOF/GO nanocomposites synthesized with different concentrations of Ce(NO<sub>3</sub>)<sub>3</sub> and 1,3,5-BTC respectively. It seemed that 1,3,5-BTC concentrations played a more significant role in tuning the morphology of Ce-MOF/GO nanocomposites. In addition, the influence of reaction time on the morphology of Ce-MOF/GO nanocomposites was also investigated and as shown in Fig. S5. Due to the fast nucleation and growth of Ce-MOF, the morphologies of Ce-MOF/GO nanocomposites were almost the same with different reaction time. Finally, the Ce-MOF/GO nanocomposites synthesized with 1.0 mg·ml<sup>-1</sup> GO, 20 mM Ce(NO<sub>3</sub>)<sub>3</sub>, 20 mM 1,3,5-BTC for 1 min were employed in the following experiments.



Fig. S4 Influence of Ce(NO<sub>3</sub>)<sub>3</sub> concentrations on the morphology of Ce-MOF/GO nanocomposites. (a) 10 mM, (b) 20 mM, (c) 30 mM, (d) 40 mM



Fig. S5 Influence of 1,3,5-BTC concentrations on the morphology of Ce-MOF/GO nanocomposites. (a) 10 mM, (b) 20 mM, (c) 30 mM, (d) 40 mM



Fig. S6 Influence of reaction time on the morphology of Ce-MOF/GO

nanocomposites. (a) 1 min, (b) 3 min, (c) 5 min, (d) 7 min



Fig. S7 Enlarged Raman spectra of Ce-MOF/GO nanocomposites after different

calcinations treatment in Fig. 1(D)



Fig. S8 SEM images of Ce-MOF/GO nanocomposites calcinated at 450 °C in Air (a,b) and Ar (c,d) atmosphere with different magnifications



Fig. S9 (b-c) EDX mapping of (a) Ce-MOF/GO nanocomposites after calcinations at 450 °C under Ar atmosphere



Fig. S10 (a) and (b) are TEM and HRTEM images of Ce-MOF/GO nanocomposites after calcination at 450 °C in Air, inset in Fig. S10 (a) is corresponding SAED pattern.

(c) and (d) are TEM and HRTEM images of Ce-MOF/GO nanocomposites after

calcination at 450 °C in Ar atmosphere, inset in Fig. S10 (c) is corresponding SAED

pattern.



Fig. S11 High resolution (a) O 1s, (b) Ce 3d XPS spectra of CeO<sub>2</sub> NWs.

Fig. S11 depicted high resolution O 1s and Ce 3d XPS spectra of samples derived from Ce-MOF/GO nanocomposites after calcination at 450 °C in Air atmosphere. Obviously, O 1s spectrum was deconvoluted to only two sub-peaks located at 529.6 eV and 531.7 eV, which ascribed to lattice oxygen and adsorbed oxygen, respectively. Compared to the XPS results of samples derived from Ce-MOF/GO nanocomposites after calcination at 600 °C in Ar atmosphere, C-O peak was not detected in O 1s spectrum due to complete oxidization of carbon in Air. And Ce 3d spectrum was deconvoluted to eight peaks as shown in Fig. S11 (b) and this was analogous to results in Fig. 2(D). And the fraction of Ce<sup>3+</sup> in Ce-MOF/GO nanocomposites after calcinations at 450 °C in Air atmosphere was estimated to be 14.2%.



Fig. S12 Typical amperometric responses of Ce-MOF/GO nanocomposites calcinated at different temperatures towards 1 mM H<sub>2</sub>O<sub>2</sub> under the same conditions



Fig. S13  $N_2$  adsorption-desorption isotherms of (a) Ce-MOF/GO nanocomposites and

(b) CeO<sub>2-x</sub>/C/rGO nanocomposites



Fig. S14 High resolution Ce 3d XPS spectra of Ce-MOF/GO nanocomposites after calcinations under (a) 700 °C and (b) 800 °C in Ar atmosphere. N<sub>2</sub> adsorptiondesorption isotherms of Ce-MOF/GO nanocomposites after calcinations under (c) 700 °C and (d) 800 °C in Ar atmosphere.

Samples	Ce-MOF/GO nanocomposites	Ce-MOF/GO nanocomposites after calcinations under 600 °C	Ce-MOF/GO nanocomposites after calcinations under 700 °C	Ce-MOF/GO nanocomposites after calcinations under 800 °C
Ce <sup>3+</sup> /(Ce <sup>3+</sup> + Ce <sup>4+</sup> ) ratios	/	19.1%	19.7%	20.1%
Specific surface area (m <sup>2</sup> g <sup>-1</sup> )	29.5	93.7	40.9	32.1

Table S1 Ce<sup>3+</sup>/(Ce<sup>3+</sup>+Ce<sup>4+</sup>) ratios in different samples and specific surface area of Ce-MOF/GO nanocomposites with different treatment

Table S2 Comparison of performances of uric acid biosensors based on CeO<sub>2-x</sub>/C/rGO nanocomposites with other substrates reported in the past

## decade

Substrate	Working Potential	Sensing mechanism	Sensitivity	Linear range	Detection limit	Ref
CeO <sub>2-x</sub> /C/rGO nanocomposites	-0.4 V vs. SCE	H <sub>2</sub> O <sub>2</sub> reduction	284.5 μA·cm <sup>-2</sup> ·mM <sup>-1</sup>	49.8-1050 μM	2.0 µM	This work
Thionine-Single Wall nanotube	-0.4 V vs. SCE	H <sub>2</sub> O <sub>2</sub> reduction	90 μA·cm <sup>-2</sup> ·mM <sup>-1</sup>	2-2000 µM	0.5 μΜ	1
Chitosan-carbon nanotubes nanofibe/AgNPs	-0.35 vs. Ag/AgCl	O <sub>2</sub> reduction	340.8µA·cm <sup>-2</sup> ·mM <sup>-1</sup>	1-400 µM	1 µM	2
Plussian blue	-0.05 V vs. Ag/	H <sub>2</sub> O <sub>2</sub> reduction	N/A	30-300	10	3
Ni <sup>2+</sup> -modified Prussian blue	-0.05 V vs. Hg/Hg <sub>2</sub> Cl <sub>2</sub>	H <sub>2</sub> O <sub>2</sub> reduction	26.9 μA·cm <sup>-2</sup> ·mM <sup>-1</sup>	2.5-200 μM	0.65 μΜ	4
Polyaniline/Prussian blue composite	0 V vs. Ag/AgCl	H <sub>2</sub> O <sub>2</sub> reduction	$160 \ \mu A \cdot cm^{-2} \cdot mM^{-1}$	10-160 μM	2.6 µM	5
Prussian blue	0 V vs. SCE	PB redox	150	0.1-0.6		6
Iron oxide nanoparticles/chitosangraft- polyaniline	0.4 vs. Ag/AgCl	H <sub>2</sub> O <sub>2</sub> oxidation	440 $\mu$ A·cm <sup>-2</sup> ·mM <sup>-1</sup>	0.1-800 μM	0.1 µM	7
ZnO nanosheets	0.4 vs. Ag/AgCl	H <sub>2</sub> O <sub>2</sub> oxidation	129.81 μA·cm <sup>-2</sup> ·mM <sup>-1</sup>	50-2000 μM	0.019 µM	8

#### References

- D. X. Chen, Q. Wang, J. Jin, P. Wu, H. Wang, S. Q. Yu, H. Zhang, C. X. Cai, Anal. Chem., 2010, 82, 2448-2455.
- A. Numnuam, P. Thavarungkul, P. Kanatharana, Anal. Bioanal. Chem., 2014, 406, 3763-3772.
- S. Piermarini, D. Migliorelli, G. Volpe, R. Massoud, A. Pierantozzi, C. Cortese, G. Palleschi, Sens. Actuat. B: Chem., 2013, 179, 170-174.
- D. Iveković, M. Japec, M. Solar, N. Živković, Int. J. Electrochem. Sci., 2012, 7, 3252-3264.
- 5. B. Thakui, S. N. Sawant, ChemPlusChem 2013, 78, 166-174.
- M. L. Moraes, U. P. Rodrigues Filho, O. N. Oliveria, M. Ferreira, J. Solid State Eelectrochem., 2007, 11, 1489-1495.
- 7. R. Devi, C. S. Pundir, Sens. Actuat. B: Chem., 2014, 193, 608-615.
- R. Ahman, N. Tripathy, N. K. Jang, G. Khang, Y.-B. Hahn, Sens. Actuat. B: Chem., 2015, 206, 146-151.