Supporting Information

Au nanoparticles supported on functionalized two-dimensional titanium carbide for the sensitive detection of nitrite

Huiyan Zou[a,1], Feifei Zhang[a,1], Haiyan Wang[a], Jianfei Xia[a], Linna Gao[b], Zonghua Wang[a*]

a College of Chemistry and Chemical Engineering, Shandong SinoJapanese Center for Collaborative Research of Carbon Nanomaterials, Qingdao University, Qingdao 266071, China.

b College of Chemistry and Environmental Engineering, Shandong University of Science and Technology, Qingdao 266590, China

* Corresponding author.

E-mail: wangzonghua@qdu.edu.cn

Fax: +86-532-85950873; Tel: 86-532-85950873.

1 These authors contributed to this work equally

Experimental

1. Reagents and materials

Titanium aluminum carbide (Ti_3AlC_2) powder was obtained from Forsman Scientific Co., Ltd. (Beijing, China). Disodium hydrogen phosphate (Na_2HPO_4), sodium dihydrogen phosphate (NaH_2PO_4), chloroauric acid ($HAuCl_4$), sodium nitrite ($NaNO_2$), potassium chloride (KCl), hydrofluoric acid (HF), ethylene glycol (EG) and sodium chloride (NaCl) were obtained from Sinopharm Chemical Reagent Co., Ltd. (Shanghai, China). All chemicals were of analytical grade and were used as received. 0.1 M phosphate buffer solution (PBS) with pH of 7.0 prepared from NaH_2PO_4 and Na_2HPO_4 was chosen for the electrolyte solution. Double-distilled water was used throughout the experimental process.

2. Instruments and measurements

Electrochemical experiments were performed at a CHI660E electrochemical workstation with a conventional three-electrode system. A bare or modified glassy carbon electrode (GCE) was employed as the working electrode, a platinum column as the counter electrode, and a saturated calomel electrode (SCE) as the reference. Electrochemical impedance spectra (EIS) measurements were conducted by Princeton Applied Research (USA). Nitrogen sorption isotherm plots (a Quadrasorb SI analyzer).

3. Synthesis of Au NPs/$Ti_3C_2T_X$

Overall, 20 mg of $Ti_3C_2T_X$ was dispersed in 20 ml of ethylene glycol under ultrasonic agitation, then 1 ml, 2 ml, 3 ml, 4 ml, 5 ml, 6 ml, 7 ml, 8 ml, 9 ml and 10 ml of 1 wt% $HAuCl_4$ aqueous solution was added to the dispersion respectively, which were then sonicated for 30 min. Each dispersion was adjusted to pH 10.0 with KOH, heated at 120 °C, and refluxed for 6 h. Cl^- was washed off and the dispersion was dried at 60 ℃ for 12 h to obtain nanocomposite Au NPs/$Ti_3C_2T_X$.

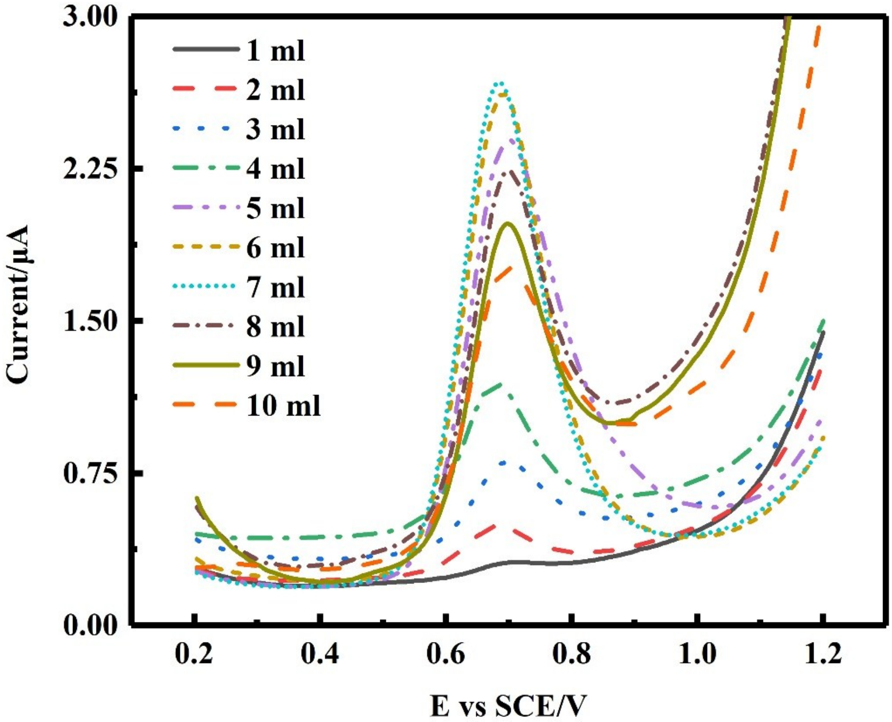

Fig. S1. The DPV curves of adding1 ml, 2 ml, 3 ml, 4 ml, 5 ml, 6 ml, 7 ml, 8 ml, 9 ml and 10 ml of 1 wt% $HAuCl_4$ aqueous solution synthetic composite nanomaterial Au NPs/$Ti_3C_2T_X$ modified electrode in 0.1 M PBS (pH 7.0) containing 1 mM $NaNO_2$.

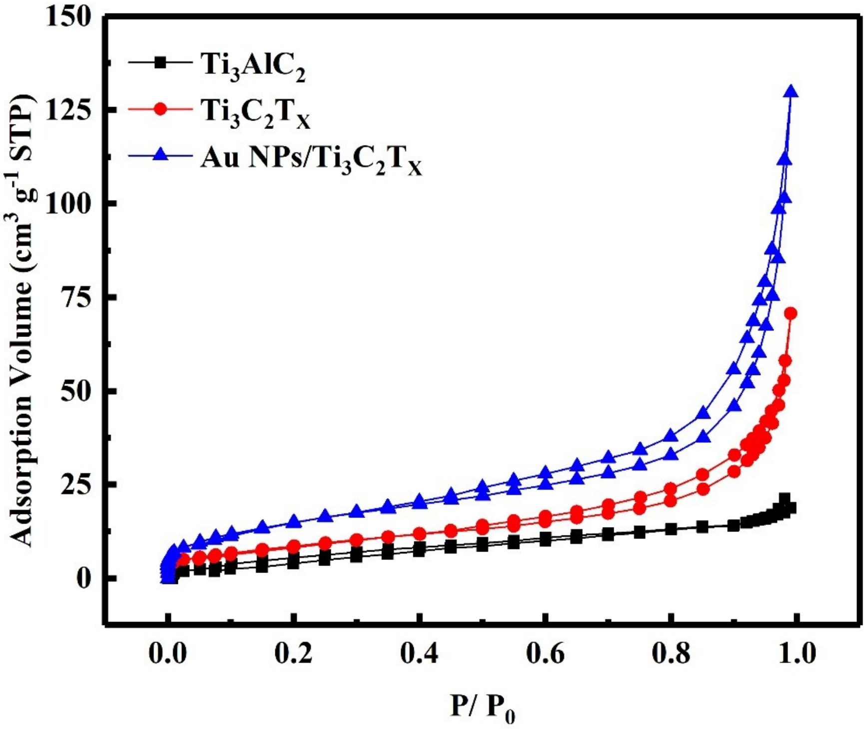

Fig. S2. Nitrogen sorption isotherm plots of Au NPs/$Ti_3C_2T_X$, $Ti_3C_2T_X$ and Ti_3AlC_2.

The nitrogen adsorption analysis of Au NPs/$Ti_3C_2T_X$ showed a specific surface area of ~44.2m^2 g^{-1}, which was higher than $Ti_3C_2T_X$ (~13.47m^2 g^{-1}) and Ti_3AlC_2 (~8.311 m^2 g^{-1}) (Fig. S2). The increase in the specific surface area of Au NPs/$Ti_3C_2T_X$ is attributed to the nanoparticle structure of Au NPs and the ability of Au NPs to prevent stacking of $Ti_3C_2T_X$ sheets.

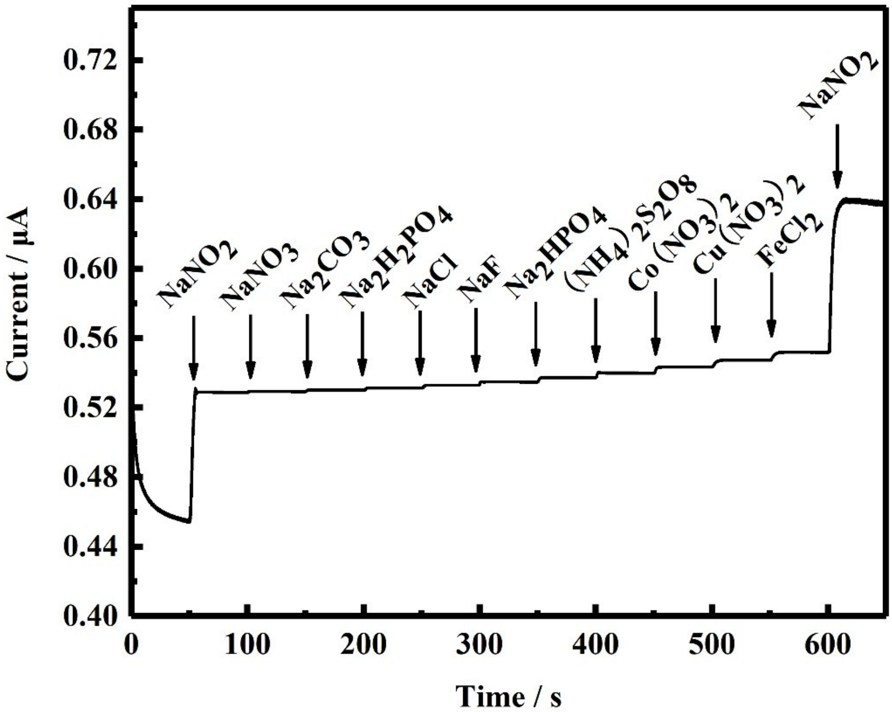

Fig. S3. Amperometric curve of Au NPs/$Ti_3C_2T_X$ modified electrode after the injection of 50 μM nitrite into 10 mL of 0.1 M PBS (pH 4.0) containing 20-fold concentrations of $NaNO_3$, Na_2CO_3, NaH_2PO_4, NaCl, NaF, Na_2HPO_4, $(NH_4)_2S_2O_8$, and 2-fold concentrations of $Co(NO_3)_2$, $Cu(NO_3)_2$, and $FeCl_2$ at 0.70 V (vs. SCE), respectively.