Supporting Information

Interfacial synthesis of ultrathin two-dimensional $2PbCO_3 \cdot Pb(OH)_2$ nanosheets with high enzyme mimic catalytic activity

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General remarks

Characterization: The atomic force microscopy images were recorded on Bruker Multimode 8 AFM with Nanoscope V controller. Scanning electron microscopy (SEM, JEOL, JSM-7500F, Japan) was used to investigate the structure of the as-prepared the nanosheets structures at an accelerating voltage of 5.0 KV. The morphological and crystalline characteristics of the films were further investigated by TEM (JEOL, JSL-2100) and selected area electron diffraction operating at a 200 kV accelerating voltage. The parameters were as follows: Al Kα (1486.6 eV, 150 W) radiation was used as the X-ray source, the vacuum degree of the chamber was 3.6×10^{-9} mbar and the scan range was -10-1350 eV. The X-ray diffraction patterns of the samples were recorded using Cu-Kα (1.54060 Å) radiation at 40 kV and 40 mA at ambient temperature (by a 2-theta range of 5–120° and a step size and rate of 0.04° and 5 seconds, respectively) of an X-ray diffractometer (XRD, Bruker Advance 2). The lattice parameters were determined by the Rietveld refinement method. N_2 adsorption isotherms were measured up to 1 bar at 77 K using a Micrometrics ASAP 2460 surface area analyzer. All UV-visible absorption spectra were obtained by using a U2910 model UV-visible spectroscope (Hitachi).

General experimental procedures

Materials and Methods

Chemicals

Lead (Pb), Lead sub-carbonate ($2PbCO_3\cdot Pb(OH)_2$), Cupric Acetate Monohydrate ($Cu(CH_3COO)_2\cdot H_2O$), hexamethyldisilazane (HMDS) and copper acetate were all purchased from Tansoole and used as received. All aqueous solutions were prepared using Milli-Q water.

HMDS modified SiO_2/Si substrates

Surface modification of SiO_2/Si substrates by HMDS was carried out according to previous literatures. The samples were first cleaned ultrasonically several times in in *n*-hexane and chloroform. Then the substrates were submerged piranha solution at 80°C for 1 h and cleaned with pure water. Subsequently, the samples were dried at 90°C to remove the liquid water from the surfaces. The dried samples were exposed to the HMDS vapor at 110°C. The treatment was carried out in a vacuum desiccator that contained liquid HMDS in equilibrium with its vapor, and the samples to be modified were placed in a petri dish. The samples were exposed to the HMDS

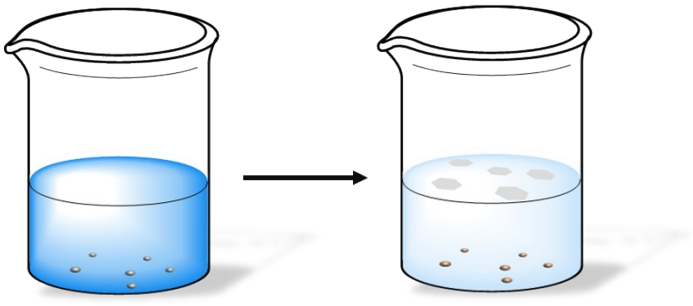
vapor under vacuum for 4 h.

Synthesis of the 2D nanosheets $2PbCO_3 \cdot Pb(OH)_2$

30 mL solution of $Cu(COOCH_3)_2$ (0.01 mM) in H_2O was added to a 50 mL beaker containing 120.0 mg Pb particles. The reaction system was left undisturbed for 12 hours. The blue color of the Cu^{2+} faded and copper metal appeared at the surface of the Pb gradually. Ultrathin 2D nanosheets formed at the interface were then transferred onto hexamethyl disilazane (HMDS) modified SiO_2/Si substrates or Cu TEM grid by bringing the substrate close to the interface in the horizontal direction (Langmuir−Schäfer method) for further characterization analysis. For catalysis studies, a suspension of 2D nanosheets was collected by carefully sucking the interface and washing it by water for several times. To get the catalyst concentration, we took out 10 mL of the dispersing liquid and removed water in vacuo to get the weight and concentration of catalyst.

Table S1. The position, Wyckoff position, occupancy and temperature factor of $2PbCO_3 \cdot Pb(OH)_2$

Atom	Wyckoff position	*x*	*y*	*Z*	Occupancy	Beq(Å^2)
Pb1	6c	0.0000	0.0000	0.2847(1)	0.96(2)	0.45(2)
Pb2	18h	0.4148(4)	0.5852(4)	0.1665(4)	0.1667	0.72(5)
C1	6c	0.0000	0.0000	0.0736(3)	1	1
O1	18h	0.9039(34)	0.0961(34)	0.0736(3)	1	18.37
O2	18h	0.7248(40)	0.2752(40)	0.1407(5)	0.3333	1



$Cu(CH_3COO)_2\ (aq)+Pb(s) \rightarrow Pb(CH_3COO)_2\ (aq)+Cu(s)$

Figure S1. Schematic illustrations of synthesis through displacement reaction

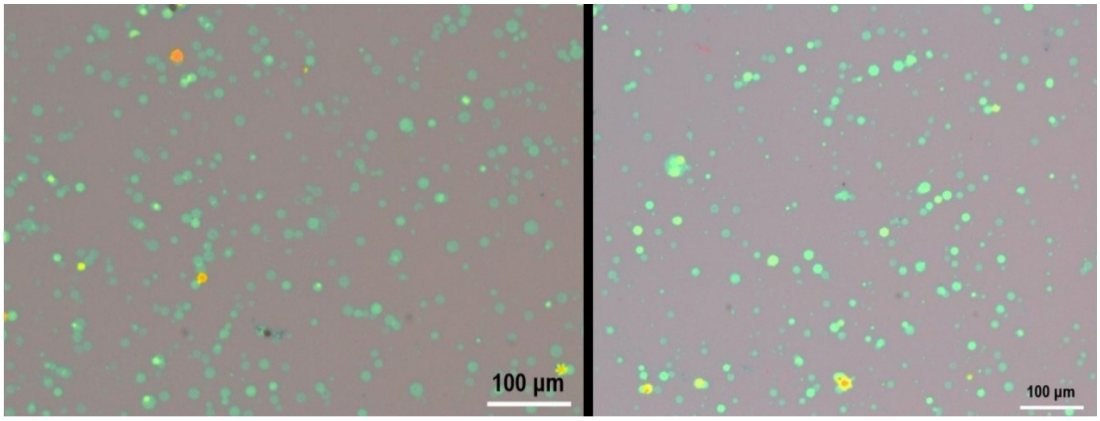


Figure S2. Optical microscopy for hexagonal structures on HMDS/Si(100).

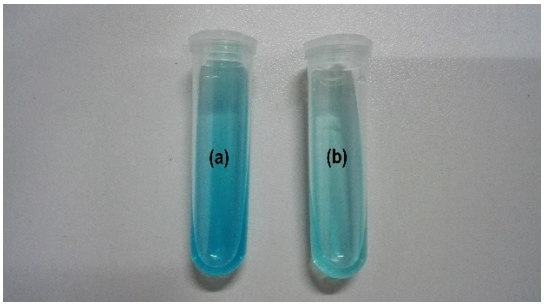


Figure S3. Photograph of H_2O_2 (13.3 mM) and TMB (0.5 mM) solutions in the presence of the prepared 2D nanosheets and the commercial $2PbCO_3 \cdot Pb(OH)_2$ (400 μL,1.33 mg/mL).(a) the prepared 2D nanosheets (b) the commercial $2PbCO_3 \cdot Pb(OH)_2$.

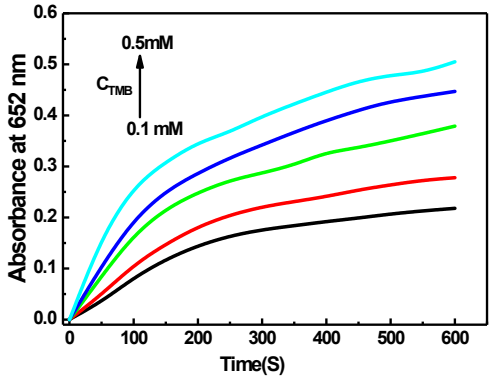


Figure S4. The time-dependent absorbance changes at 652 nm in the presence of the nanosheets with various concentrations of TMB.

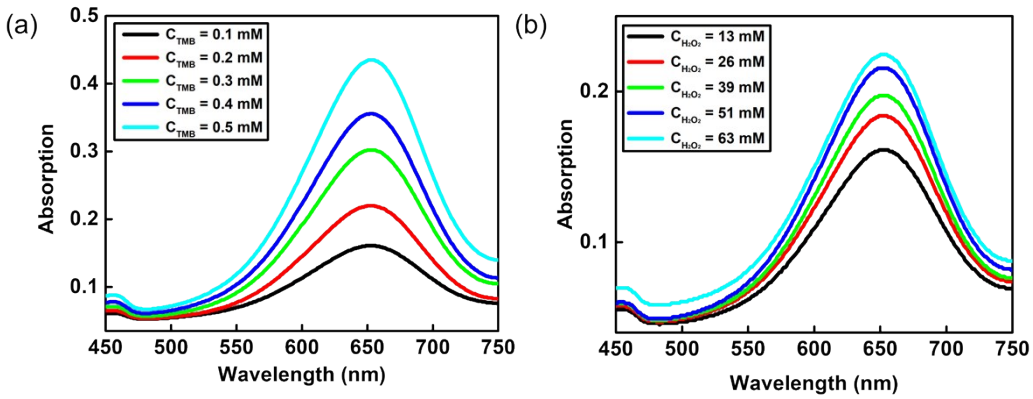


Figure S5. (a) UV-visible spectra of TMB (0.1-0.5 mM) and H_2O_2 (13 mM) solutions in the presence of the nanosheets. (b) UV-visible spectra of TMB (0.1 mM) and H_2O_2 (13-63 mM) solutions in the presence of the nanosheets.

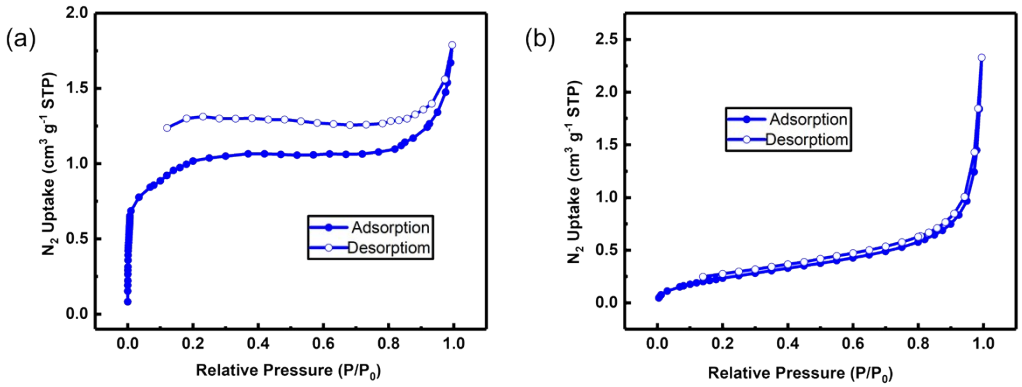


Figure S6. N_2 adsorption−desorption isotherms (77 K) of the 2D nanosheets (a) and the commercial $2PbCO_3 \cdot Pb(OH)_2$ (b)