Supplementary material

MoS_2/PDA@Cu Peroxidase-Mimicking Enzyme with High Effect Antibacterial and Anticancer Activity

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1 Materials Synthetic

1.1 Preparation of PDA

In a typical experiment, 50mg DA were dissolved in 100ml Tris buffer (10mM pH=8.5) to prepare the PDA. The reaction was carried out at room temperature for 6 h under dark conditions. After the reaction, the product was separated by centrifuging at 7000 rpm for 5 min and washed with water and ethanol three times, and PDA were prepared.

1.2 Preparation of PDA@Cu

40mg PDA and 0.5 g Copper acetate were added into 250ml anhydrous ethanol stirring for 2 h. After, the above solution was set aside for 12 h, the precipitate separated and was then dispersed into 200 mL ethanol. Next, 0.445 g $NaH_2PO_2 \cdot H_2O$ was dissolved in a 50 mL ethanol solution, which acted as a reducing agent. Then, the re-prepared PDA mixed in the $NaH_2PO_2 \cdot H_2O$ solution was added into a 250 mL round-bottom flask refluxed in an oil bath at a temperature of 80 ℃ for 30 min. The following treatment method was the same as for the preparation of PDA, and finally PDA@Cu nano material was prepared.

1.3 Preparation of MoS_2 Modified By Cupper Acetate

40mg MoS_2 and 0.5 g Copper acetate were added into 250ml anhydrous ethanol stirring for 2 h. After, the above solution was set aside for 12 h, the precipitate separated and was then dispersed into 200 mL ethanol. Next, 0.445 g $NaH_2PO_2 \cdot H_2O$ was dissolved in a 50 mL ethanol solution, which acted as a reducing agent. Then, the re-prepared MoS_2 mixed in the $NaH_2PO_2 \cdot H_2O$ solution was added into a 250 mL round-

bottom flask refluxed in an oil bath at a temperature of 80 ℃ for 30 min. The following treatment method was the same as for the preparation of PDA, and finally MoS_2@Cu nano material was prepared.

2 The Preparation for Antibacterial Experiments

2.1 Preparation of Samples

The samples were dispersed in sterilized PBS buffer, diluted to an appropriate concentration with sterilized PBS buffer, and irradiated under uv lamp for 30 min for backup use.

2.2 Dilution of Inoculation Liquid

1 mL of bacterial suspension was taken after 18 h of oscillation and diluted with sterilized PBS buffer. The absorbance (OD) of the diluted bacterial suspension was measured by UV-vis spectrophotometer until the OD value was 0.03.

2.3 Constant Temperature Water Bath Oscillation

2 mL of diluted bacterial suspension was placed in a 10 mL centrifuge tube, and 1 mL of the sample to be tested was added. The centrifuge tube was placed in a constant temperature water bath oscillator at a rotational speed of 150 r/min at 37 ℃ for 18 h, and the plate antibacterial experimental bacterial suspension was obtained.

2.4 Preparation of Culture Medium

Pour 30 mL of sterilized medium into sterilized petri dish and cool naturally in ultra-clean workbench.

2.5 Petri Dish Inoculation

After shaking for 18 h, 50 μL of bacterial suspension was absorbed with a pipette

gun, then inoculated on the AGAR medium after cooling and solidification, and evenly coated with sterile coating stick for 3 times.

2.6 Constant Temperature Incubator Culture

The coated petri dishes and the blank control petri dishes without samples were placed in a 37 ℃ constant temperature and humidity box at the same time for 18-24 h culture (there are changes according to different strains).

2.7 Record The Results

The petri dishes were taken out and the colony photos of each petri dish were taken. The photos were imported into Image J software to calculate the colony number.

3. Cu Ion dissolution test

The 0.05 mg/ml sample of MoS_2 modified by cupper acetate and MoS_2/PDA@Cu were dispersed with DI water. After quiescence for one day, they were filtered using a filter with 0.22 μm pore size and detected using Inductive Coupled Plasma Emission Spectrometer (ICP).

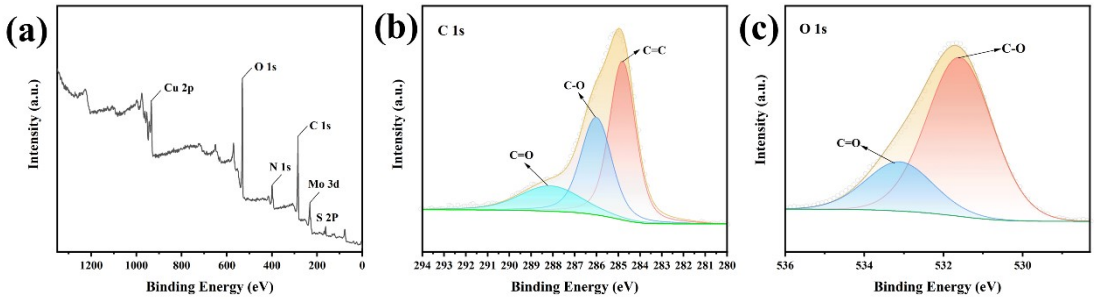

Figure. S1 XPS survey patterns of (a) MoS_2/PDA@Cu, (b) C 1s spectra, (c) O 1s spectra of MoS_2/PDA@Cu

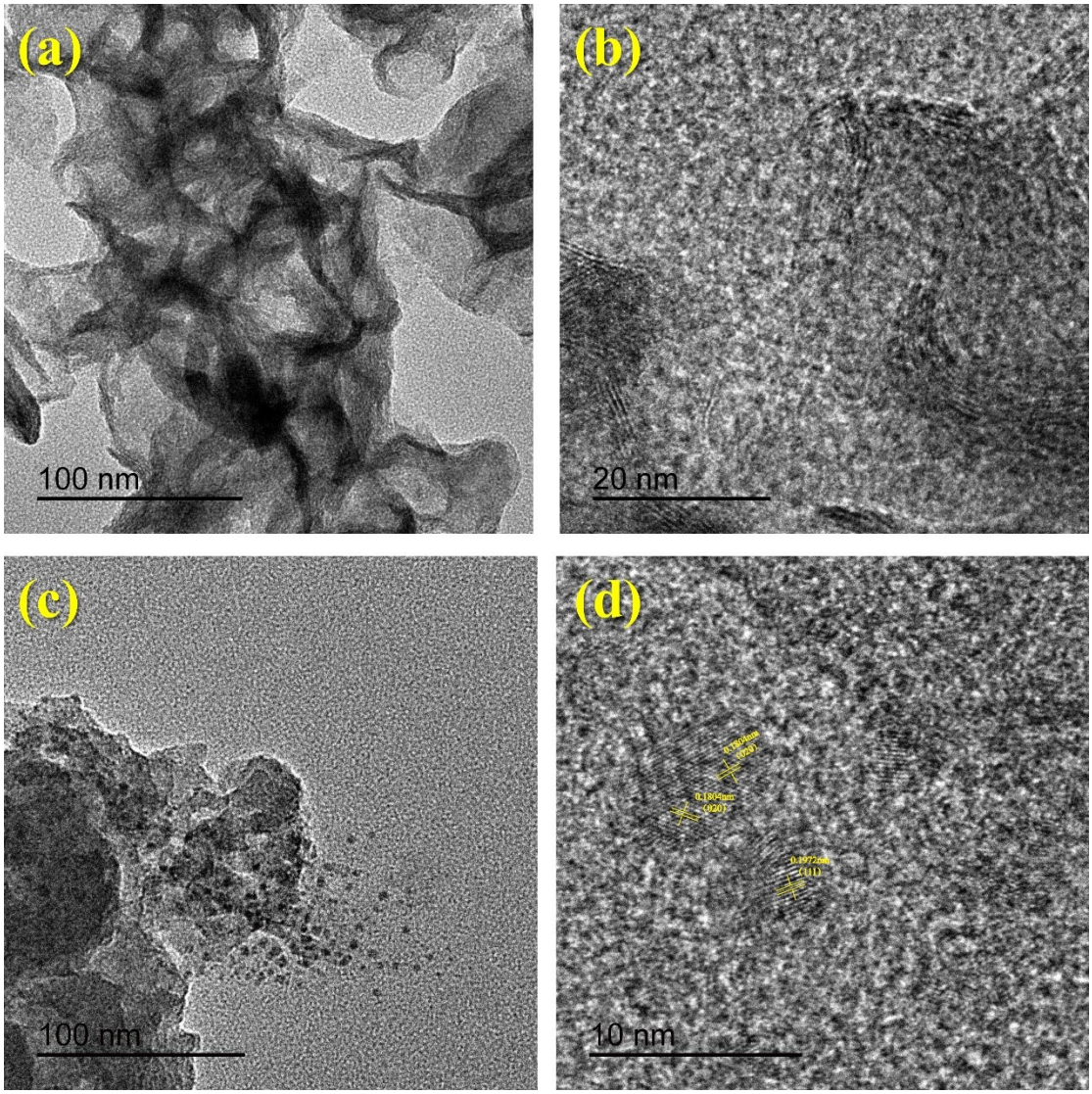

Figure. S2 TEM images (a-b) MoS_2 modified by cupper acetate, (c-d) PDA@Cu

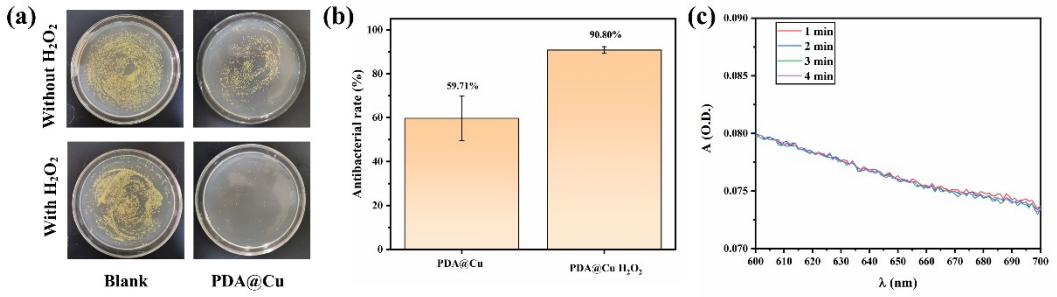

Figure. S3 (a) Growth situation of *S. aureus* treated by PDA@Cu, (b) (c) The absorbance changes of PDA@Cu (100 μg/ml, 0.5 ml) in the solution, which contained TMB (0.5 mM, 0.5 ml), H_2O_2(100 mM, 1 ml) and citrate buffer, were measured by UV-vis spectrophotometer (600 nm to 700 nm)

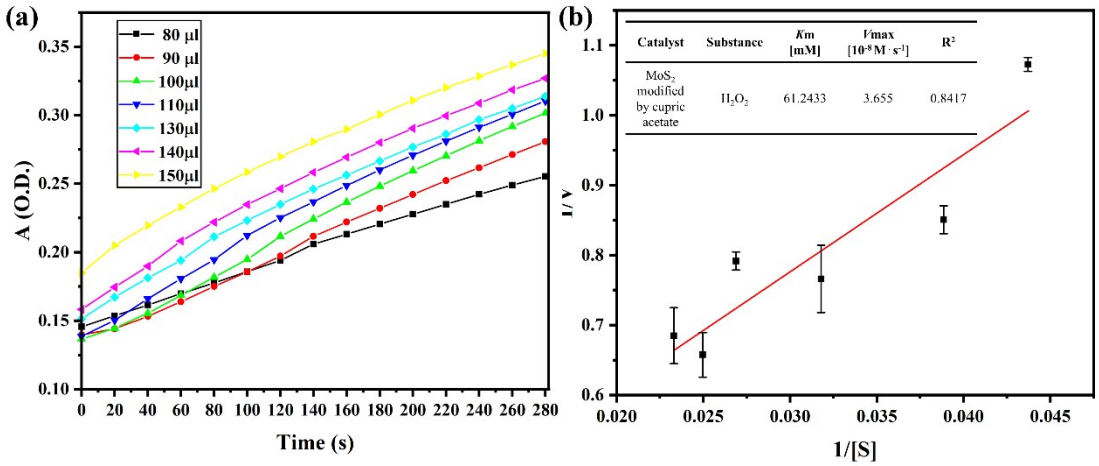

Figure. S4 (a) Time-dependent absorbance changes of MoS_2 modified by cupper acetate (60 μg/ml) at 652 nm of TMB (1.5 mM) with different volume of H_2O_2 (100 mM) in a pH 4.0 Citrate buffer (0.2 M) at 25℃; (b) Double-reciprocal plot of the calculation of initial reaction rate and substrate concentration of MoS_2 modified by cupper acetate.

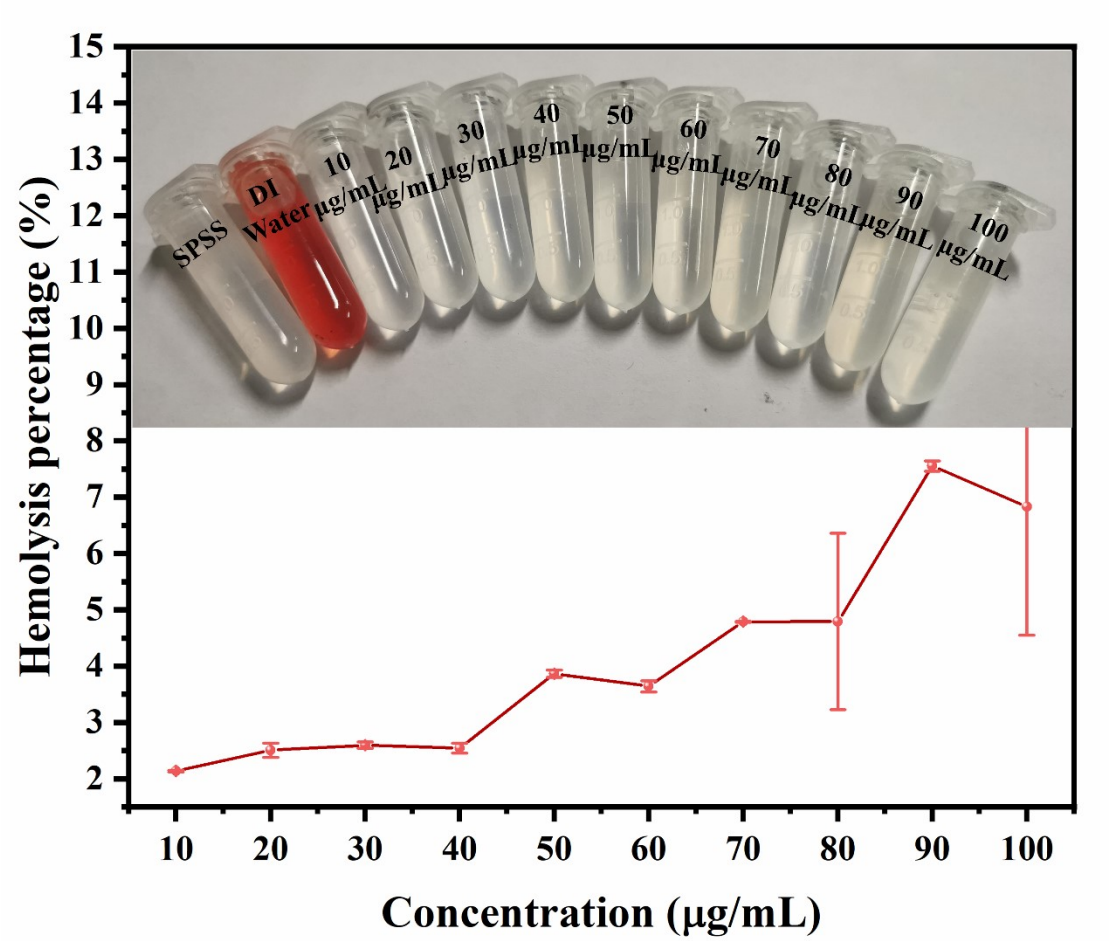

Figure S5 Hemolytic percentage of RBCs after incubated with MoS_2 modified by cupper acetate at different concentrations (10 ~ 100 μg/mL) for 3 h; inset image is results of hemolysis assay.

Table S1 Cu ion dissolution concentration

Sample	Cu ion concentration (mg/L)	Standard deviation (mg/L)
MoS_2 modified by cupper acetate	12.1825	0.0816
MoS_2/PDA@Cu	0.6114	0.0113