Supporting Information

The First Visually Observable Three-mode Antibiotic Switch and its Relative 3D Printing Assisted Applications

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Experimental Section

1.1 Preparation of the CPSN hybrid solution

The carbon dots (CDs) were synthesized by pyrolysis of ethylenediaminetetraacetic acid disodium salt (EDTA-2Na), according to report of Shen Dezhen's group.[1] The synthesis method of carbon packaged silver nanoparticles (CPSN) was inspired from Wang Jianhua and co-workers' work.[2] 25 mL original carbon dots were diluted to 100 mL, and then adjusted it to PH=7 by ammonium hydroxide, followed by ultrasonication for a few minutes. Tollens stock solution was freshly prepared,[3] containing about 25 mM $Ag(NH_3)_2OH$ and 1mM $NH_3 \cdot H_2O$. 1mM fresh tollen's reagent was added into CDs solution, which was heated and stirred under reflux. The reaction mixture was further heated and stirred under reflux for another 1h. The final product, consisting of yellow carbon packaged silver nanoparticles (CPSN) solution, was obtained subsequently.

1.2 Cell toxicity

L929 cells were cultured in Dulbecco's modified Eagle's medium (DMEM, GIBCO) with 10% fetal bovine serum (FBS) in a humidified incubator at 37℃ under conditions of 5% CO_2, and the culture medium was replaced once every day. Cells were seeded in 96-well plates after digested by trypsin and grown overnight. 10μL CPSN and the mixture within PBS were added to each well of the 96-well plates respectively, after incubation for 6 h, 10 μL CCK-8 reagent was added in cell culture dish, followed by an additional 2 h incubation at 37℃. Afterward, enzyme standard instrument was used to measure the absorbance at 450 nm.

1.3 Antibacterial activity

Escherichia coli, Staphylococcus aureus and methicillin-resistant *Staphylococcus aureus,* as the represents of Gram-negative, Gram-positive strains and clinical drug resistant strains, were isolated from orthopedics infection patients. These pathogens were cultured on Luria-Bertani (LB) broth overnight at 37℃. 5 mL of LB broth, 100 μL of the as-prepared bacterial suspension and 1 mL of CPSN (or the mixture of CPSN and PBS) was put sequentially into a 10 mL tube. The reaction mixture was then incubated in orbital shaker at 37℃ for 6 h. Afterward, the reaction solution was serially diluted for 1×10^5 times with PBS and 50 μL of the dilution was spread on the solid LB agar plate. The colonies were formed after 24 h cultured at 37℃. The inhibition rate (IR) was determined by distinguishing the number of colony-forming units (CFU). The IR was calculated by the following equation:

$$IR = \frac{C_0 - C}{C_0} \times 100\%$$

Where C is the number of experimental group's CFU after treated with CPSN, CPSN+PBS1, CPSN+PBS2, and C_0 is the number of control group's CFU without any treatment.

1.4 Statistical analyses

The data, cell survival rate and bacterial inhiitionn rate, were analyzed by repeated-measures ANOVA to determine the significance of individual difference at $P<0.05$ level. All statistical analyses were carried out using SPSS statistical software package.

1.5 3D printed device fabrication

3D-printed cap consists of two parts, which was designed by Computer Aided Three-dimensional Interactive Application (CATIA), with 50 mm diameter and 52 mm height. 500 μL (0.04 M) PBS was poured into the top part before encapsulated by tetradecyl alcohol. The holes of the other part were blocked by tetradecyl alcohol, then the test unit of *Escherichia coli* O157 was integrated with the printed cap (as the Figure 3 showed). Prior to experiment, around 10^8 bacteria were cultured in the bottle with the 3D-printed cap. Afterward, 10 mL CPSN were added into the middle part of the cap, and the top part was then fixed on the top of it. The result of the test strip was positive indicating that a mass of bacteria existed in the sample. Subsequently, the sealed sample bottles with 3D-printed cap were incubated in the oven under 50℃ for about 25 min, and then placed in rocking incubator at 37℃ for 5 h after the PBS and CPSN flowed into it when tetradecyl alcohol was melted. Afterward, the consequence of the new test unit turned to negative, signifying the number of bacteria decreased markedly. The plate count method was adopted to further confirm the consequence.

1.6 Animal model

All experiments were performed in compliance with the relevant laws and approved by the Institutional Animal Care and Use Committee at Institute of Translational Medicine, Nanchang University. Nine-week healthy male KM mice with body weight ranging from 33 g to 35 g were selected from the Laboratory Animal Science of Nanchang University and kept under standard condition with enough food and water before starting experiment. The animals were divided into two groups (n=3) randomly: control group and experiment group. Experimental mice were continuous intraperitoneally injected with the same concentration of CPSN under mode “ON” (CPSN+PBS1) at 100μL/10g levels once a day for 7 days and the blank group were fed normally without any processing. Relative body weight and mortality were recorded every day. One day after final injection, the mice were sacrificed and the organs were received for ICP-MS tests.

1.7 The design concept of an intelligent band-aid model

A piece of clearn non-woven fabric after sterilization by UV absorbed a certain amount of PBS. At room temperature, another part of non-woven fabric was soaked in CPSN solution, and then placed as the bottom layer to form multifunctional non-woven fabrics.

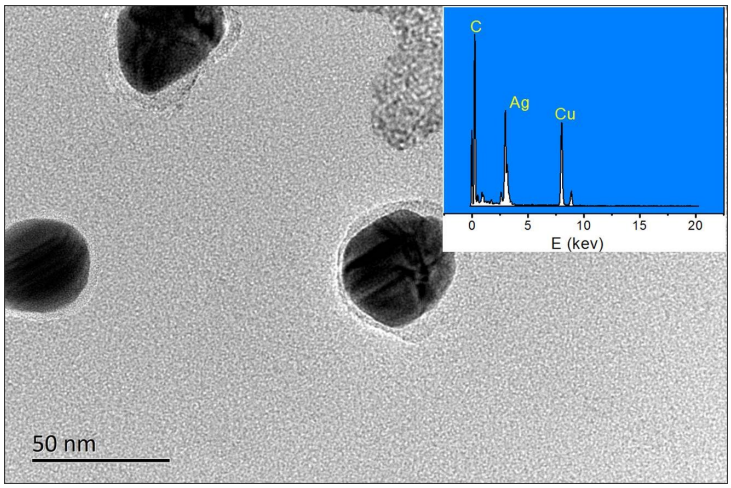

Figure S1 TEM images (Inset: EDS) of prepared CPSN.

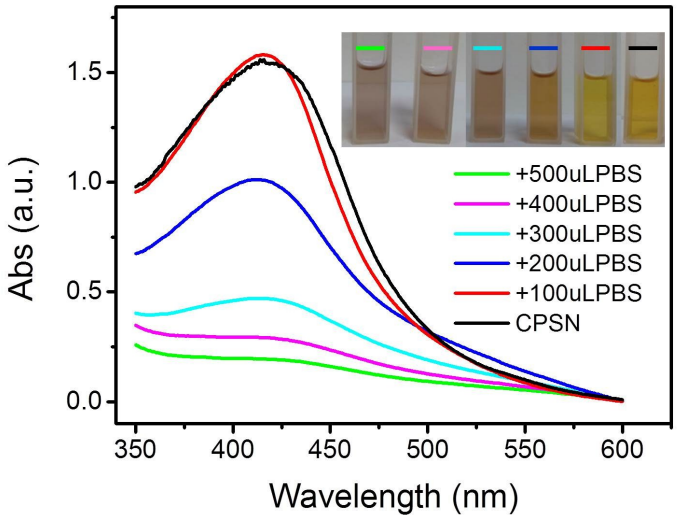

Figure S2 UV-vis absorption spectra of CPSN with different volume of PBS, Inset: photographs of CPSN solution in the presence of 0, 100, 200, 300, 400 and 500 μL PBS (0.04 M).

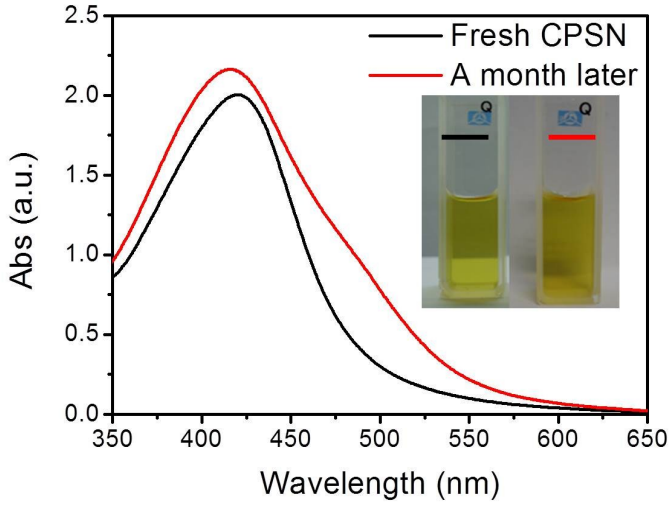

Figure S3 UV-vis absorption spectra of CPSN before and after a month. Inset: corresponding photographs.

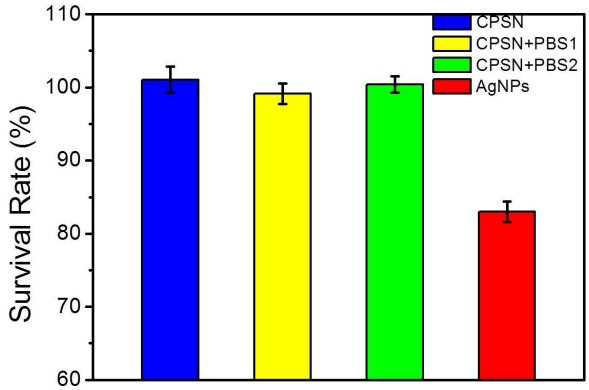

Figure S4 The survival rate of L929 cells (B) after co-cultivated with CPSN solution, CPSN+PBS1, CPSN+PBS2 and AgNPs (7-8 nm), respectively.

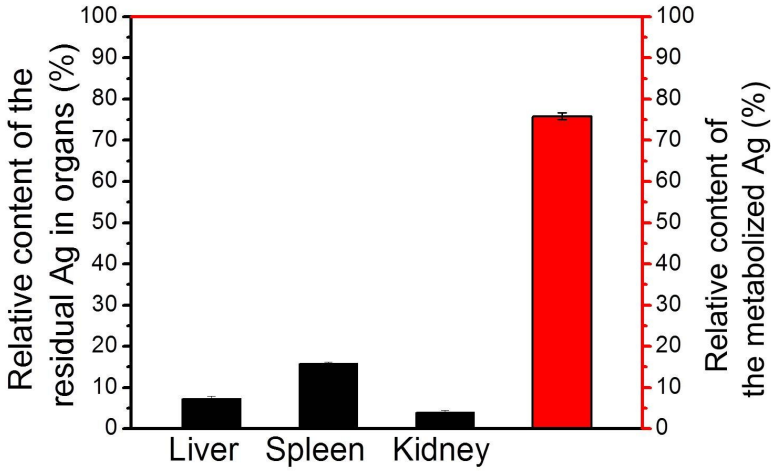

Figure S5 Relative contents of the residual Ag in different organs (liver, spleen and kidney) detected by ICP-MS and the relative content of the metabolized Ag.

[1] Y. Deng, D. Zhao, X. Chen, F. Wang, H. Song, D. Shen, *Chemical Communications* **2013**, *49*, 5751-5753.

[2] S. Chen, X. Hai, X.-W. Chen, J.-H. Wang, *Analytical Chemistry* **2014**, *86*, 6689-6694.

[3] J.-b. Zeng, S.-g. Fan, C.-y. Zhao, Q.-r. Wang, T.-y. Zhou, X. Chen, Z.-f. Yan, Y.-p. Li, W. Xing, X.-d. Wang, *Chemical Communications* **2014**, *50*, 8121-8123.