Silver-Modified β-Cyclodextrin Polymer for Water Treatment: A Balanced Adsorption and Antibacterial Performance

Xin Wang [1], Huafeng Chen [2], Jianyu Wang [2], Yi Zhou [2], Changzheng Cui [2] and Yanbo Zhou [1,2,*]

[1] School of Carbon Neutrality Future Technology, East China University of Science and Technology, No. 130 Meilong Road, Shanghai 200237, China; wangxinvicky@163.com
[2] State Environmental Protection Key Laboratory of Environmental Risk Assessment and Control on Chemical Process, East China University of Science and Technology, No. 130 Meilong Road, Shanghai 200237, China; lscschf@163.com (H.C.); lscschf@163.com (J.W.); yizhou@ecust.edu.cn (Y.Z.); cuichangzheng@ecust.edu.cn (C.C.)
* Correspondence: zhouyanbo@ecust.edu.cn; Tel.: +86-21-64250225

2.2 Antibacterial experiment

2.2.1 Preparation

All the glass instruments and consumables in this experiment are wet-sterilized in an autoclave (121°C) for 20 minutes before use.

The configuration of phosphate buffer solution (PBS): Place 0.24 g KH_2PO_4, 1.42 g Na_2HPO_4, 8.0 g NaCl and 0.2 g KCl into a beaker containing an amount of ultrapure water. After fully dissolving, adjust the pH to 7.2-7.4 and volume with distilled water to 1000 mL.

The configuration of the liquid medium: Place 0.6 g beef extract, 2.0 g peptone and 1.0 g NaCl in a 500 mL conical flask containing 200 mL ultrapure water, fully dissolved by magnetically stir.

The configuration of solid agar medium: Place 0.6 g beef extract, 2.0 g peptone, 1.0 g NaCl and 2.0 g agar in a 500 mL conical flask containing 200 mL ultrapure water, fully dissolved by magnetically stir.

Preparation of CD-CA/PDA-xAg dispersions of adsorbed antibacterial materials: Place 30 mg CD-CA/PDA-xAg into a 5 mL centrifuge tube, then add 3 mL PBS buffer to form 10 mg/mL adsorbent antibacterial material dispersion. Finally, ultra-dispersed for 30 minutes, until the material is evenly dispersed in the buffer.

2.2.2 The experiments of inhibition zone

The 100 μL bacterial solution with the concentration of 10^6 CFU/mL was obtained by pipette gun on agar medium, and spread the plate evenly with a coating rod. Then 5 pieces of filter paper with a diameter of about 8.0 mm were placed on the medium with tweezers. Around the filter paper, 30.0 μL of the dispersion solution of the CD-CA/PDA-xAg were added to the surface of the 4 filter papers. After the treatment, the mediums are cultured in a constant temperature biochemical incubator (37°C) for a certain period of time (12 hours for *Escherichia coli* and 36 hours for *Staphylococcus aureus*), and the size of the inhibition zones is compared.

2.2.3 The experiments of colony forming unit

To form a dosage of 1g/L, 20 mg of materials was added in a centrifuge tube containing 20 mL of liquid culture medium with a bacterial concentration of about 10^8 CFU/mL. The centrifuge tube was shaken at 37 °C, 150 rpm for 24 h. 100 μL of the diluted bacterial solution was injected into the center of the agar medium and spread evenly. After the treatment, the mediums are cultured in a constant temperature biochemical incubator (37 °C) for a certain period of time (12 hours for *Escherichia coli* and 36 hours for *Staphylococcus aureus*), and the number of colonies was counted.

2.6. Characterisation of antibacterial adsorbent

Take a small amount of sample in the bullet, and add an appropriate amount of absolute ethanol. After ultrasonic dispersion, the aboved was dropped on the silicon wafer (FESEM) or copper mesh (TEM). After completely dried, it was then taken to FESEM and TEM for scanning analysis.

The sample was dried thoroughly and grinded evenly. The aboved sample was pressed into the tablet, and then the tablet was put into the sample tank for FT-IR scanning analysis

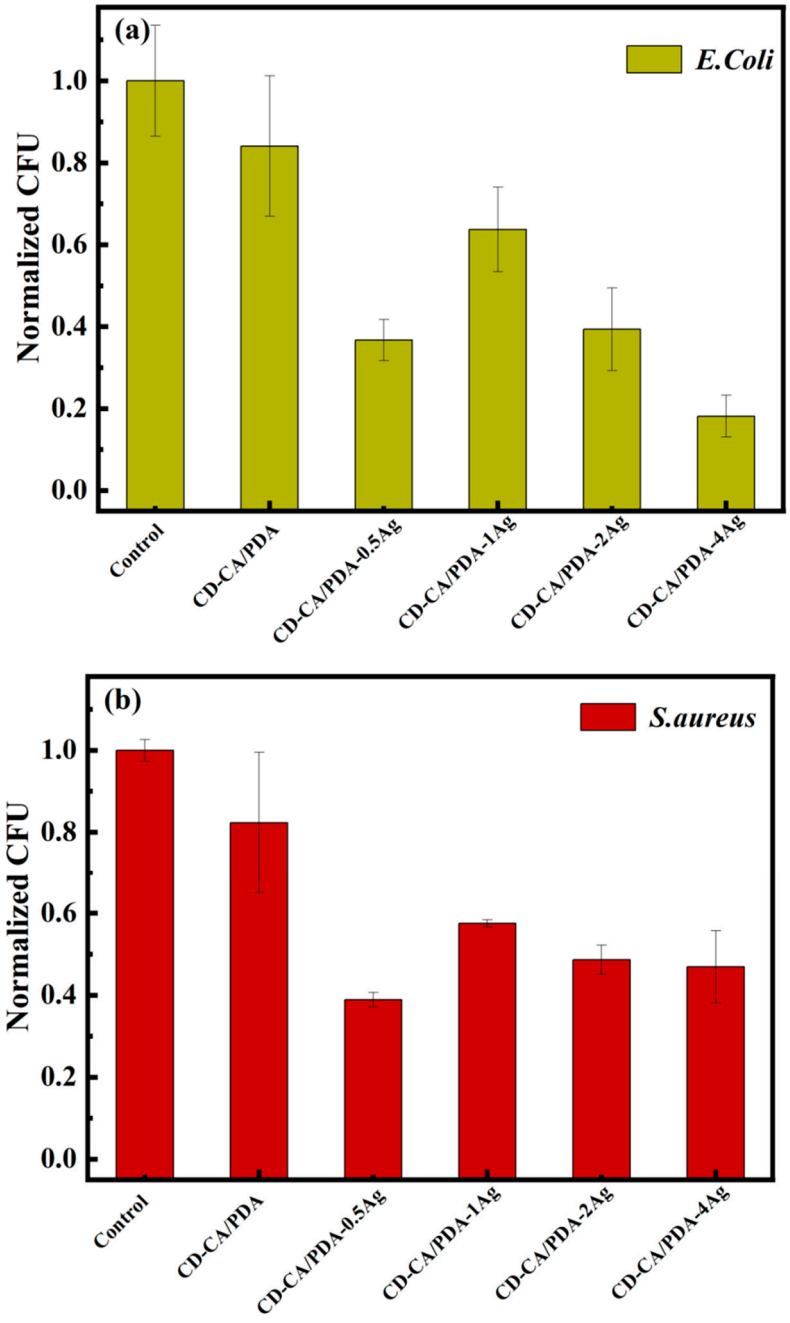

Figure S1. Colony forming unit tests of CD-CA/PDA and CD-CA/PDA-xAg to *E. coli* (a) and *S. aureus* (b)