

Electronic Supplementary Information

Bioinspired Metal-Cell Wall-Metal Sandwich Structure on Individual bacterial Cell Scaffold

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Experimental Section

Materials: Ultrapure water was used for the preparation of various solutions and washing processes. All reagents used in this study were all analytical grade obtained from Beijing Chemical works (China) and without further purification. The bacillus subtilis (GSY 1027-ts301) obtained from Chinese Academy of Sciences was cultured in a brewis medium in a constant temperature incubator and collected by centrifugation.

Introduction of Pd nanoparticles to cells (Formation of cell@PNPs): PdCl₂ (0.05 g) was dissolved in hydrochloric acid solution (45 ml, 1:2 (v/v) mixture of HCl and H₂O) with magnetic stirring at room temperature. After PdCl₂ was completely dissolved, the collected cells were immersed in PdCl₂ solution with magnetic stirring for 10 min at room temperature. Then, the SnCl₂ (0.2 g) was added to the PdCl₂ solution and stirred for 10 min at room temperature. After the SnCl₂ was completely dissolved, another SnCl₂ (1.6 g) was added to the PdCl₂ solution and stirred for 30 min at 30 °C to introduce Pd nanoparticles to cells forming cell@PNPs. The cell@PNPs was recollected by vacuum filtration, and washed thoroughly with 1 M hydrochloric acid solution and water.

Introduction of the metallic layers to cells (Formation of cell@metal): The cell@PNPs was dispersed into electroless plating solution with a mechanical stirrer, which contained Nickel sulfate and Cobalt sulfate (concentration of total metallic ions is 0.1 M), sodium citrate of 30 g L⁻¹, ammonium chloride of 50 g L⁻¹, sodium hypophosphite of 25 g L⁻¹, and thiourea of 10⁻⁵ g L⁻¹. The solution was maintained at 35 °C, and the pH was adjusted at 9.2 with 4 M ammonia water. After 120 min, the cell@metal was formed and separated by filtering and washing thoroughly with water. Then, the cell@metal was washed with ethanol and acetone, and collected by vacuum filtration.

Characterization: Field-emission scanning electron microscopy (FE-SEM) imaging was performed with an APPLO 300 microscopy (CamScan, UK) with an accelerating voltage of 10 KV. Transmission electron microscope imaging (TEM), High-resolution TEM (HRTEM), selected area electron diffraction (SAED) measurement and energy-dispersive X-ray (EDX) spectroscopy elemental analysis were performed using a JSM 2100 instruments (JEOL, Japan). FT-IR spectra were performed by using a FT-IR spectra instrument (Nicolet 6700, U.S.). X-ray diffraction (XRD) analysis was recorded on a D/max 2200PC (Rigaku, Japan) instrument equipped with Cu

K α radiation ($\lambda=1.54178 \text{ \AA}$) over the 2θ range of 10-80°. Magnetic characterization was performed on a BHV-50HTI vibrating sample magnetometer (VSM, Riken Denshi, Japan) at 300 K.

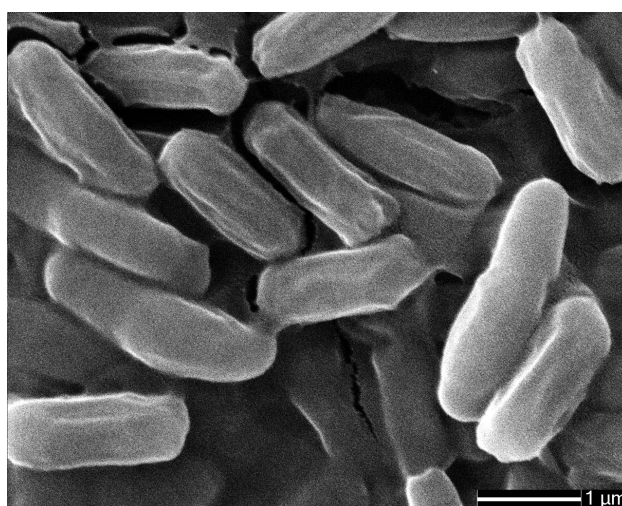


Fig. S1 SEM image of the native *Bacillus* cells.

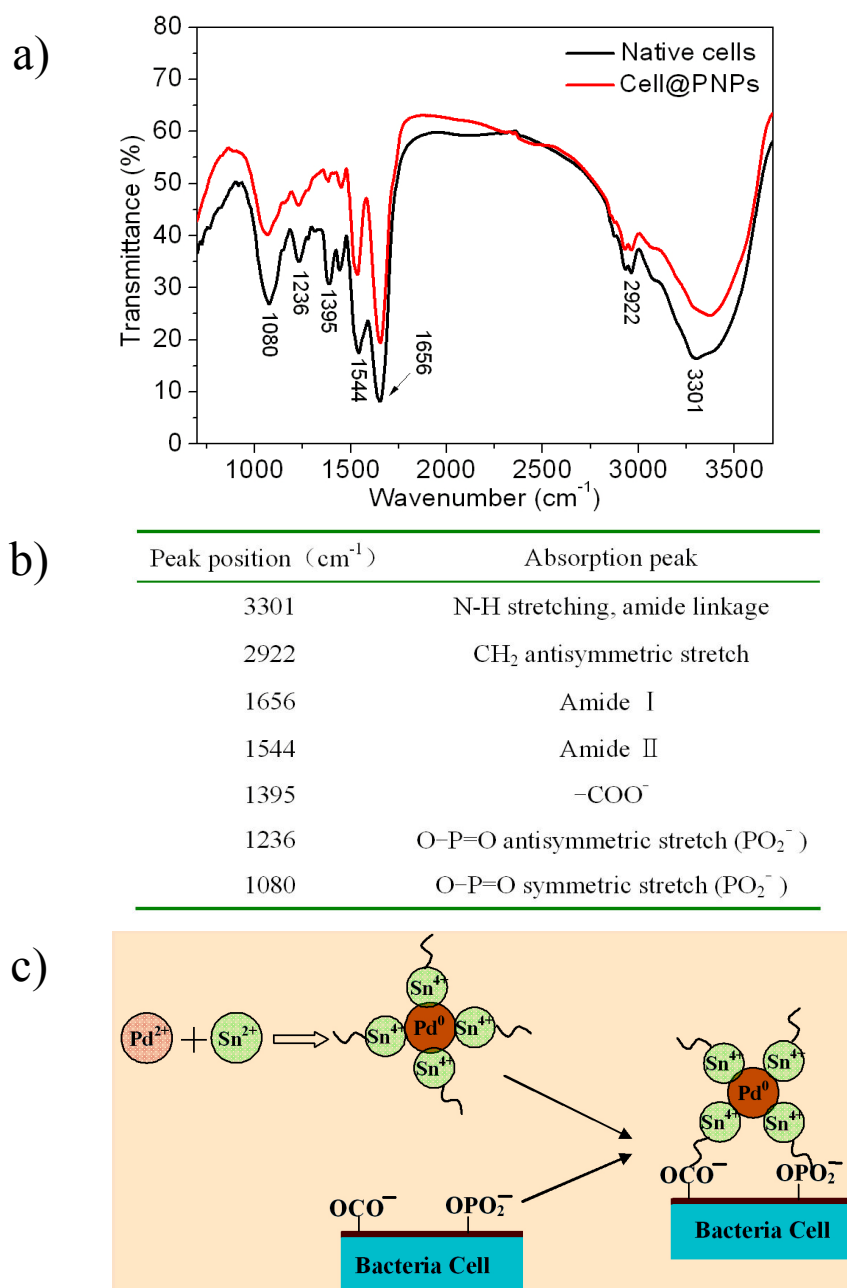


Fig. S2 a) FT-IR spectra of the native bacillus cells and the cell@PNPs, and b) Frequencies and assignments of absorption peaks found in the FT-IR spectra; c) Schematic representation for the formation of the Pd nanoparticles (PNPs) covered by charge carrier, which, subsequently, interacted with the functional groups of cell walls via electrostatic interaction.¹⁻³

Table S1 The magnetic properties of the cell@metal formed at different experimental conditions. That mole ratio of the metallic Co^{II} ions to the total ions of Co^{II} and Ni^{II} was 0.2, 0.4, 0.6 and 0.8 ($R= 0.2, 0.4, 0.6$ and 0.8).

Conditions	Saturation Magnetization (emu/g)	Remnants Magnetization (emu/g)	Coercitive Force (Oe)
$R= 0.2$	24.29	2.21	33.24
$R= 0.4$	27.98	3.42	81.64
$R= 0.6$	46.67	5.37	99.81
$R= 0.8$	65.42	9.02	188.35

References

- 1 P. Lascha, M. Boeseb, A. Pacificoa, M. Diem, *Vib. Spectrosc* 2002, **28**, 147.
- 2 G. A. Toole, M. Kačuráková, A. C. Smith, K. W. Waldron, R. H. Wilson, *Carbohydr. Res.* 2004, **339**, 629.
- 3 C. L. Chen, N. L. Rosi, *Angew. Chem. Int. Ed.* 2010, **49**, 1924.