Supplementary Information

*In situ* Synthesis of a Mesoporous MIL-100(Fe) Bacteria Exoskeleton

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Experimental

Materials

LB Broth Base medium was supplied by Invitrogen. LB Broth Base medium with agar, iron(III) nitrate nonahydrate and trimesic acid were obtained from Sigma-Aldrich. Live/Dead BactLight Bacterial viability Kit (L7007) was supplied by Thermo Fisher. Milli-Q water was sterilized in autoclave for solution preparation.

Bacterial culture

_Pseudomonas putida_ (CFBP 5039) were obtained from CIRM-CPFB (collection of bacteria associated with plants, maintained by the International Center of Microbial Resources, Angers, France). _P. putida_ was cultured in LB Broth Base medium. Stock culture was stored in aliquots in 30% glycerol at -80°C. Pre-culture was prepared from frozen stock by adding 100 µL of _P. putida_ thawed suspension to 10 ml of LB medium followed by 24 h incubation under orbital shaking (150 RPM) at 30°C. Bacteria concentration after 24-hour incubation was determined by plate-counting using LB agar plates. Final pre-culture suspension (1.5 ± 0.6.10⁸ CFU/mL) were used to prepare subsequent bacterial cultures. For this purpose, 100 µL of pre-culture suspension were added to 10 mL of LB medium and re-incubated under shaking (150 RPM) at 30°C for 24 h. Concentration of bacteria in final suspension was determined using plate-counting resulting in 1.2 ± 0.6 *10⁸ CFU/mL.

The growth cycle of _Pseudomonas putida_ CFBP 5039 was determined by measuring the optical density (OD) at 600 nm. After 24 h, bacteria concentration was 1.2 ± 0.6 *10⁸ cfu/mL, determined by plate-counting. Briefly, 100 µL bacterial suspension and diluted solutions were spread on LB agar gel and incubated at 30 °C for 24 h. LB agar plates containing CFU in the range of 30 – 300 were used to determine bacteria concentration.

Live-dead assay

Live-dead assay were performed using BactLight Bacterial viability Kit (Thermo Fisher). 0.5 mL sample (biohybrid or bacteria) was centrifuged (2500 RCF, 5 min, 25 °C) and washed twice with 1 mL 0.85% NaCl solution and dispersed in 1 mL 0.85% NaCl solution. 0.5 mL of the suspension was then added to 0.5 mL 0.85% NaCl solution containing 2 µL of component A of BactLight Bacterial viability kit composed of equimolar mixture of SYTO 9 dye (1.67
mM) and Propidium iodide (1.67 mM) in DMSO (original protocol supplied by Thermo Fisher was modified by adjusting dye molar ratio). The mixture was left to incubate for 15 min at room temperature in the dark, and the sample was analyzed by fluorescent microscope (Axio 100, Zeiss). Images were taken using exposition time of 1 s and 2 s for SYTO9 and PI channels, respectively.

**Instrumentation**

Powder X-ray diffraction patterns were collected using Siemens D5000 diffractometer with CuKα1 radiation (λ=1.540598 Å). Prior to powder X-ray diffraction measurements, to avoid bacterial contamination of the instrument the solid was washed with EtOH.

STEM images have been recorded on a Jeol 2100F microscope equipped with a Schottky emitter, an UHR pole piece, an X-ray energy dispersive spectrometer (XEDS) and a scanning device allowing high angle annular dark field (HAADF) imaging mode and elemental mapping.
Figure S1. *Pseudomonas putida* CFBP 5039 growth cycle in LB Broth Base medium.
Figure S2. Live/dead assay on *P. putida* after 3h (a,c) and 24h (b,d) in contact with Fe(NO$_3$)$_3$ 13 mM (a,b) and 26 mM (c,d). Magenta colored bacteria (PI) are indicative of damaged cell membranes, cyan coloured bacteria (SYTO9) display healthy membranes.
Figure S3. Live/dead assay on *P. putida* after 3h in contact with trimesic acid 8.5 mM (a) and 17 mM (b). Magenta colored bacteria (PI) are indicative of damaged cell membranes, cyan coloured bacteria (SYTO9) display healthy membranes.
Figure S4. TEM image of the bio-hybrid image of the bio-hybrid
Figure S5. STEM-HAADF images of the bare *P. putida* (a, c, d) and EDS spectrum (b). The arrow in figure (b) indicates the energy of the Fe-K\(\alpha\) line (6.4 keV).
Figure S6. STEM-HAADF images of the bio-hybrid (a, c, d) and XEDS elemental mapping (b). Iron element is represented in yellow.
Figure S7. Images of MIL-100(Fe) obtained without bacterium, SEM imaging (a,b) and TEM imaging of cross-sections (b,c).