Supplementary material

Graphene Coating as an Effective Barrier to Prevent Bacteria-Mediated Dissolution of Gold

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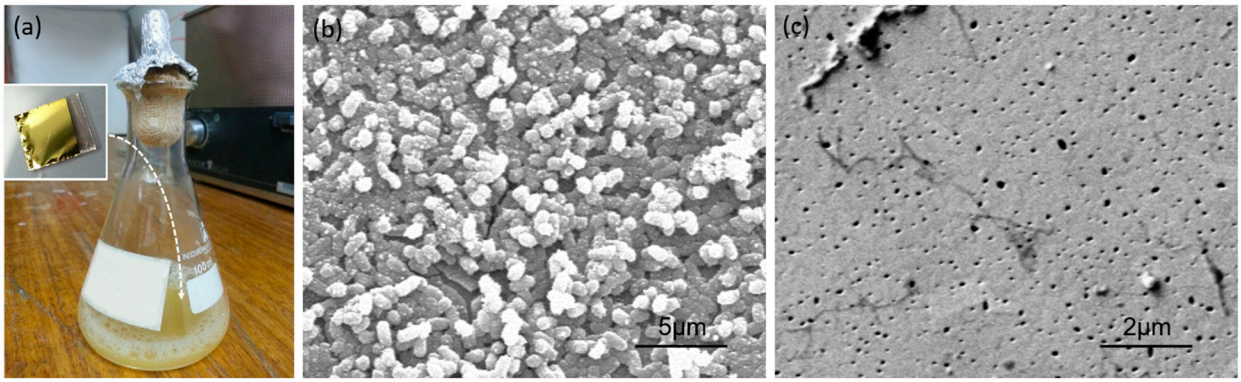

Figure S1. (**a**) Au samples (1 × 1 cm^2) were incubated in 50 ml growth medium inoculated with *C. metallidurans* and incubated in the dark at 25 °C for 60 days. (**b**) SEM image of *C. metallidurans* grown on uncoated Au sample. (**c**) SEM image of graphene-coated Au sample after 60 days incubation, confirming the absence of biofilm growth.

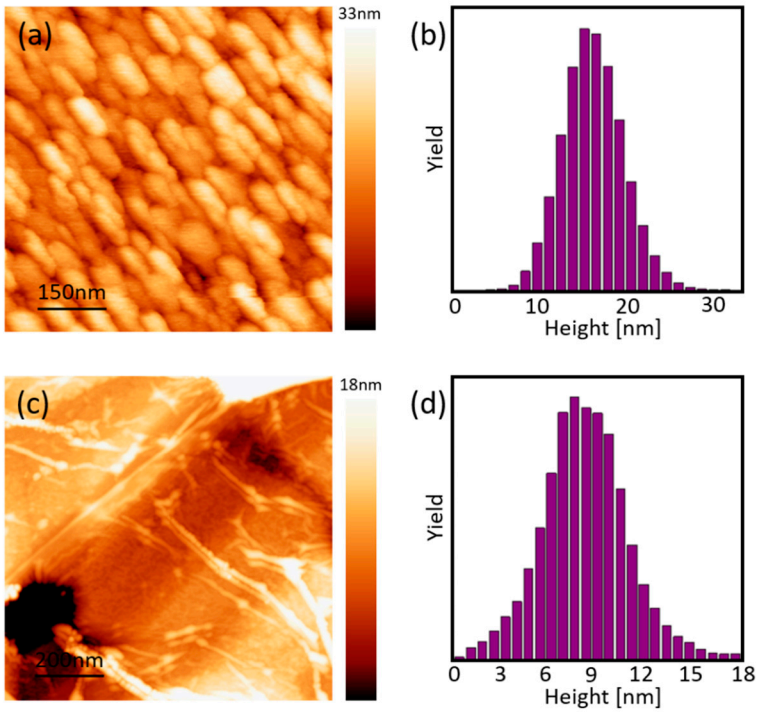

Figure S2. Roughness analysis of STM images of: (**a**), (**b**) uncoated Au samples and (**c**), (**d**) graphene-coated Au samples, after bacterial exposure.

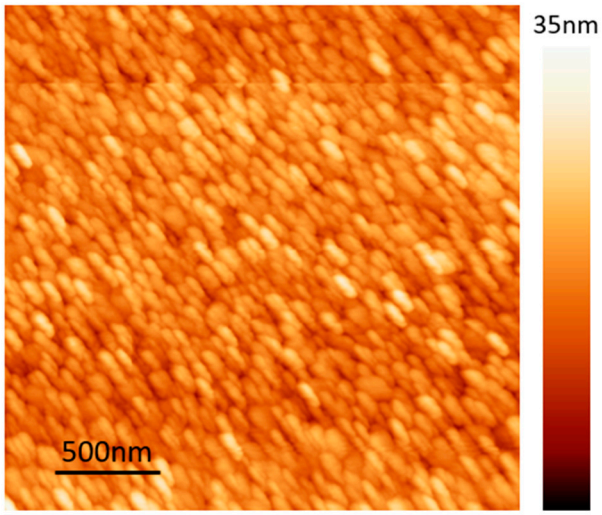

Figure S3. Large area STM image of uncoated Au samples after exposure to *C. metallidurans* (2.2 µm × 2.2 µm, I = 0.05 nA, V = 1 V).

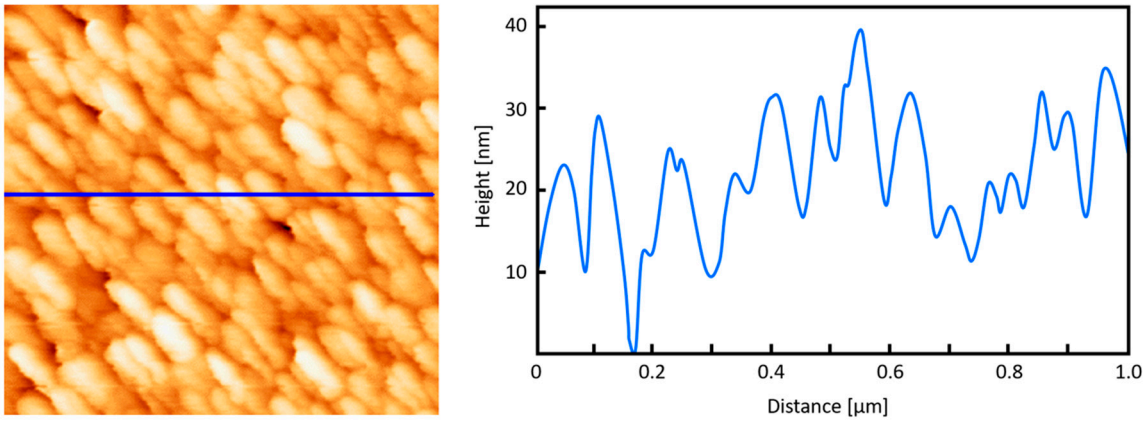

Figure S4. Height profile of Au grains found in uncoated Au samples exposed to *Cupriavidus metallidurans*.

Angular correlation analysis.

To quantify the characteristic length scales of the nanoparticulated Au structures found after exposure of uncoated samples to C. metallidurans, angular dependent correlation analysis was performed. The angle-dependent autocorrelation function $\langle G_\theta(\vec{r})\rangle$ is the result of averaging the spatial correlation function $\langle G(\vec{r})\rangle$ of all vectors with orientation θ with respect to the horizontal axis and magnitude $|\vec{r}|$.

The spatial autocorrelation function $G(\vec{r})$ of an image (STM image in our case) is defined as the statistical correlation of any two points separated by a vector $\vec{r} = \vec{r}_i - \vec{r}_j$, where $\vec{r}_i$ and $\vec{r}_j$ are the positions of those two points in the image.

$$G(\vec{r}) = \frac{1}{N(\vec{r})}\sum_{i,j}\frac{(I_i - \bar{I}_1)(I_j - \bar{I}_2)}{\sigma_1\sigma_2}$$

Where

$$N(\vec{r}) = \sum_{i,j}\delta_{\vec{r},(\vec{R}_i-\vec{R}_j)}$$

Indicates the number of points at distance $\vec{r} = \vec{R}_i - \vec{R}_j$

The average intensities (height value in an STM image) are calculated according the expressions:

$$\bar{I}_1 = \sum_{i,j}\delta_{\vec{r},(\vec{R}_i-\vec{R}_j)}I_i$$

And the standard deviations are calculated according to:

$${\sigma_1}^2 = \left(\frac{1}{N(\vec{r})}\sum_{i,j}\delta_{\vec{r},(\vec{R}_i-\vec{R}_j)}{I_i}^2\right) - (\bar{I}_1)^2$$

$${\sigma_2}^2 = \left(\frac{1}{N(\vec{r})}\sum_{i,j}\delta_{\vec{r},(\vec{R}_i-\vec{R}_j)}{I_j}^2\right) - (\bar{I}_2)^2$$

The average spatial autocorrelation function $\langle G(\vec{r})\rangle$ is the result of averaging the correlation function of all vectors with the same magnitude $|\vec{r}|$. The angle-dependent autocorrelation function $\langle G_\theta(\vec{r})\rangle$ is the result of averaging the correlation function of all vectors with orientation θ with respect to the horizontal axis and magnitude $|\vec{r}|$. The angular dependent correlation function $\langle G_\theta(\vec{r})\rangle$ was computed for an STM image of size 150 × 150 pixels (Figure 6a). $\langle G_\theta(\vec{r})\rangle$ was computed for a simplified representation of the grains observed in the STM image (Figure 6b) to identified more clearly the presence of special pattern in the distribution. Grain outlines where identified in red for this calculation. Finally, only for comparison purposes, the angle-dependent correlation function for a perfect stripe formation (Figure 6c).

$\langle G_\theta(\vec{r})\rangle$ of the STM images reveal that there is a particular spatial pattern (with local minima and maxima), implying the presence of characteristic length scales for the observed nanoparticulated gold structures. The arcs in such pattern are imperfect, but repeat with a fixed periodicity, similarly to the observed pattern at the stripes implying a pattern over large length scale. The functional form of those arcs, for a system with partially disordered regions separated by a

distance d and running along an angle α with respect to the horizontal, measured at an angle θ, is given by N*d/cos((α − 90°) − θ) [1].

1. Giraldo-Gallo, P., Zhang, Y., Parra, C., Manoharan, H. C., Beasley, M. R., Geballe, T. H., ... & Fisher, I. R. (2015). Stripe-like nanoscale structural phase separation in superconducting BaPb1− x BixO3. Nature communications, 6(1), 1-9.