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Supporting Information for:

Reversible adsorption of Iridium in lyophilized cells of the unicellular red alga *Galdieria sulphuraria*

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Supplementary materials method

Separating coefficients

Separating coefficients were determined by the experimental results of metal recovery from polymetallic solutions using lyophilized cells, ion-exchange resin, and activated carbon (Fig. 3). Value is calculated as the ratio of the elements (Ir and another element) after separation divided by the ratio before separation.

Adsorption isotherm

Ir(IV) adsorption data on lyophilized *G. sulphuraria* cells were obtained after incubating the cells in 0.2 M HCl solution containing different initial metal concentrations for 30 min at 25°C (Fig. 2). These data were analyzed using the Langmuir (Langmuir, 1918) and Freundlich (Freundlich, 1907) isotherm models. The following Langmuir isotherm equation was used:

$$Qe/Qm = (1/Qm)Ce + 1/k_L Qm,s$$

where Qe is the adsorption capacity (mg g^{-1}), Qm is the maximum adsorption capacity (mg g^{-1}), Ce is the initial concentration of the precious metals in solution (mg L^{-1}), and k_L is the Langmuir constant. The following Freundlich isotherm equation was used:

$$\lg Qe = \lg k_F + 1/n \lg Ce,$$

where Qe is the adsorption capacity (mg g^{-1}), Ce is the initial concentration of the precious metals in solution (mg L^{-1}), and k_F and n are the Freundlich constants.

Fig. S1

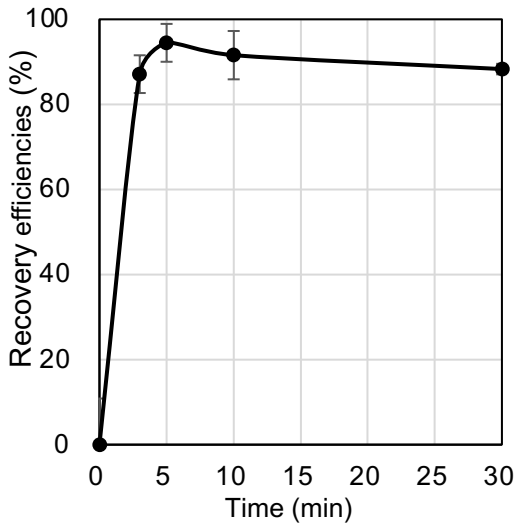

Fig. S1 Time dependence of the efficiency of Ir recovery using lyophilized *G. sulphuraria* cells. Lyophilized cells were incubated at a loading of 20 mg mL^{-1} for 30 min in 0.2 M HCl solution containing 10 ppm Ir.

Fig. S2

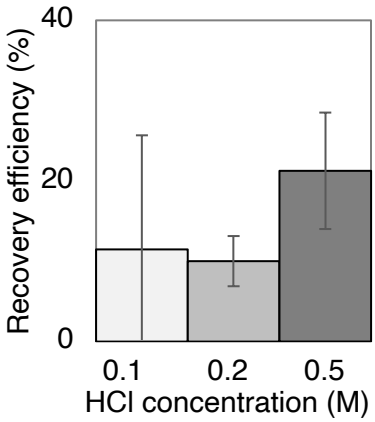

Fig. S2 Recovery efficiencies of Rh from HCl solutions containing 10 mg L^{-1} Rh. 20 mg mL^{-1} of lyophilized *Galdieria sulphuraria* cells was incubated for 30 min in HCl solutions containing 0.1–0.5 M HCl and 10 mg L^{-1} Rh. Values are expressed as the average ± standard deviation of three independent experiments.

Table S1

Table S1 Separating coefficients for Ir in lyophilized *G. sulphuraria* cells, ion-exchange resin, and activated carbon

	Ir/Rh	Ir/Zn	Ir/Cd	Ir/Mn	Ir/Fe	Ir/Cu	Ir/Ni
Lyophilized *G. sulphuraria* cells	9.8	44	11	22	1.3	15	13
Ion-exchange resin	12	9.7	1.4	11	7.9	11	31
Activated carbon	2.8	3.5	2.1	–	–	2.3	24

Fig. S3

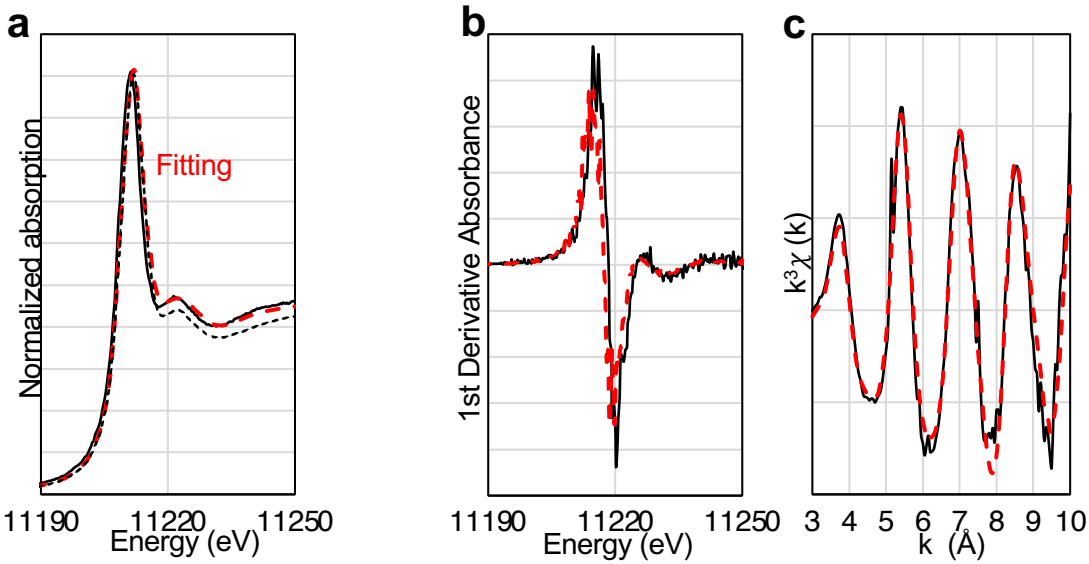

Fig. S3 Ir-L_{III} edge spectra and LC-XANES fits (a), the first derivatives of XANES spectra (b) and k^3-weighted $\chi(k)$ EXAFS spectra (c) for Ir-adsorbed lyophilized *G. sulphuraria* cells incubated for 30 min. For the linear combination (LC) fittings, 7 standards were tested for the LC fits of the Ir-adsorbed lyophilized cells. Lyophilized cells were incubated for 30 min in 0.2 M HCl solution containing 200 mg L^{-1} Ir. The LC fitting parameters were as follows: R-factor = 0.07397, reduced χ^2 = 0.02448.

Table S2

Table S2 Langmuir and Freundlich isotherm constants

Langmuir	
Qm (mg.g)	98.04
b (l/mg)	0.00
R2	1.00
Freudlich	
kF (mg/g)	0.28
n	1.46
R2	0.99

Fig. S4

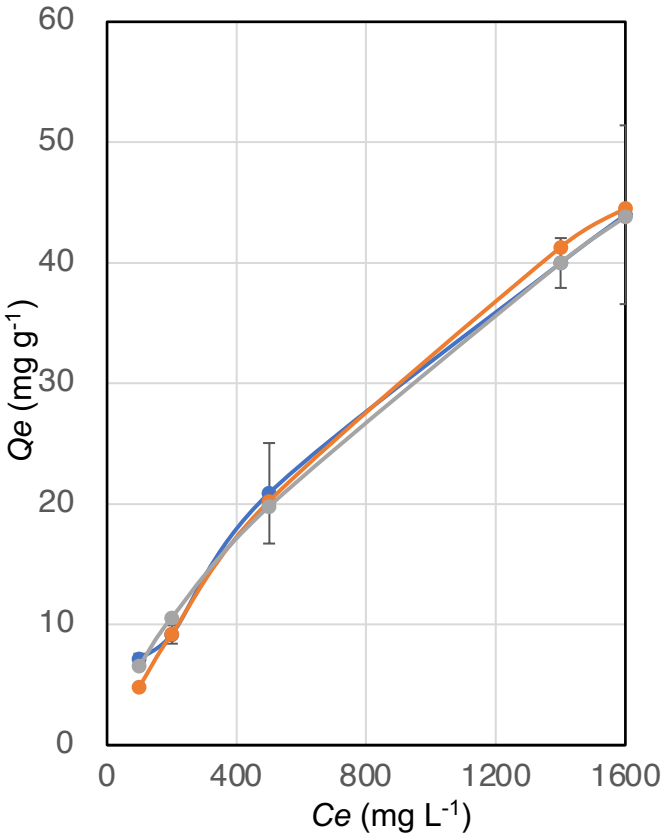

Fig. S4 Adsorption isotherms of Ir in lyophilized *G. sulphuraria* cells. Langmuir (orange) and Freundlich (blue) isotherms were compared with experimental data (black) for Ir in 0.2 M HCl solution.