Supplementary information

Experimental Details:

Growth of Magnetospirillum gryphiswaldense (M.g.), purchased from DMSZ (Germany), was carried out under microaerobic condition in sealed 100 ml vials containing 70 ml M.g. medium, which was optimized in our study based on Flask Standard Medium. The M.g. media contained (per liter deionized water) 2.38 g HEPES, 3 g sodium pyruvate, 3 g soybean peptone, 0.34 g $NaNO_3$, 0.15 g $MgSO_4 \cdot 7H_2O$, 0.1 g yeast extract, 0.1 g KH_2PO_4, 100 µM ferric citrate, and 1 ml EDTA-chelated trace element solution, which was composed of 3 mg/L $FeCl_3 \cdot 6H_2O$, 0.3 mg/L H_3BO_3, 0.06 mg/L $CuSO_4 \cdot 5H_2O$, 0.36 mg/L KI, 0.24 mg/L $MnCl_2 \cdot 4H_2O$, 0.12 mg/L $Na_2MoO_4 \cdot 2H_2O$, 0.24 mg/L $ZnSO_4 \cdot 7H_2O$, 0.3 mg/L $CoCl_2 \cdot 6H_2O$, 25.5 mg/L $EDTANa_2 \cdot 2H_2O$. The pH of the medium was adjusted to 7.0 with NaOH. Vials were sealed with butyl rubber septum, and purged with a gas mixture containing 1% oxygen and 99% nitrogen for 2 min before autoclaving to create a microaerobic condition necessary for magnetite formation.[24] Cultures were inoculated by injection through the stopper, and cultivated at 28 °C for four days.

Synthesis of Fe_3O_4/C composites: M.g. bacteria were harvested and washed with deionised water for several times. The cell pellet was dispersed in a 1.5 mL deionised water and glucose solution was subsequently added. The resulted mixture was allowed to settle overnight and then centrifuged to remove the supernatant. The cell pellet was dried at 50 ^oC for 12 h in a vacuum oven and the dried cell pellet was annealed at 350^oC under argon atmosphere for 1 h.

Characterization: The morphology of the samples was investigated with a field-emission scanning electron microscopy (FESEM, JEOL, Model JSM-6340F), and the nanostructures of

the materials were characterized with a transmission electron microscopy (TEM, JEOL, Model JEM-2010) operating at 200 kV. To observe the samples via TEM, a suspension of the material was deposited dropwisely onto carbon-coated copper grids and dried at room temperature. Crystal phases were identified using a Scintag PAD-V X-ray diffractometer with Cu KR irradiation. IR spectra were obtained with a Fourier transform infrared spectrometer (Perkin-Elmer) that was equipped with a DGTS detector and a ZnSe window. Thermogravimetric analysis (TGA, Q500) was carried out from room temperature to 500 ^{o}C at a heating rate of 10 K min^{-1} in air. Theta Probe X-ray photoelectron spectroscopy (XPS, ESCALab 250i-XL & Thetaprobe A1333) was used to verify the valence state of elements C and N.

Electrochemical Measurements: Electrochemical measurements were conducted at room temperature, using two-electrode Swagelok cells with pure lithium metal as both the counter electrode and the reference electrode.[31] The working electrode consisted of the active material (e.g., Fe_3O_4/C nanocomposites), a conductive agent (carbon black, Super P-Li) and a polymer binder [poly(vinylidene difluoride), PVDF, Aldrich] in a 70:20:10 ratio (by weight). The electrolyte consisted of 1.0 M LiPF6 in a 50:50 wt:wt solution of ethylene carbonate and diethyl carbonate. The cell was assembled in an Ar-filled glovebox with moisture and oxygen concentrations of <1.0 ppm. The charge/discharge tests were performed with a NEWARE battery tester at a current density of 120 mA/g (0.2 C) and a voltage window of 0.01-3 V.

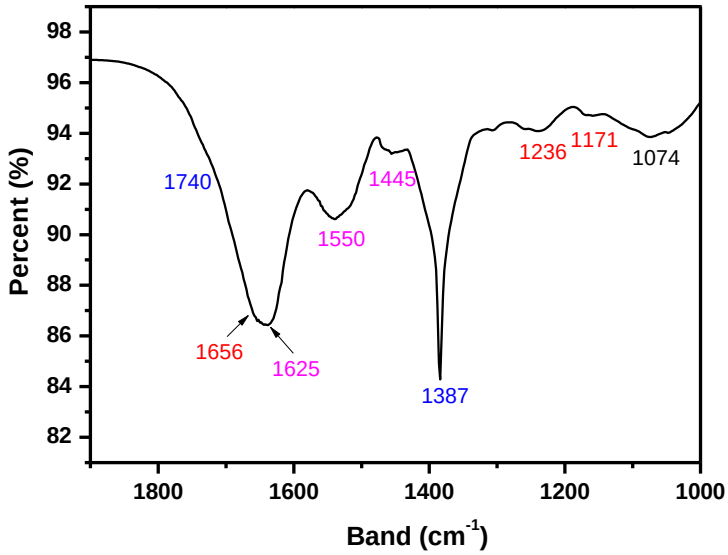

Figure S1. The FTIR spectrum of as cultivated bacteria showed characteristic absorption peaks corresponding to the C=O stretching vibration at 1740 cm^{-1} and carbonate symmetrical stretching at 1387 cm^{-1}, indicating the presence of carboxyl groups. The peaks at 1625 cm^{-1}, 1550 cm^{-1}, and 3071 cm^{-1} (not shown) are attributing to amine groups, and 1445 cm^{-1} is the characteristic peak corresponding to C-N. The peak at 1074 cm^{-1} is associated with C-S, and the broad peak from 500-700 confirm S-S bond in protein. Other peaks at 1656 cm^{-1}, 1236 cm^{-1} and 1171 cm^{-1} are related to phosphorus compounds in the sample.

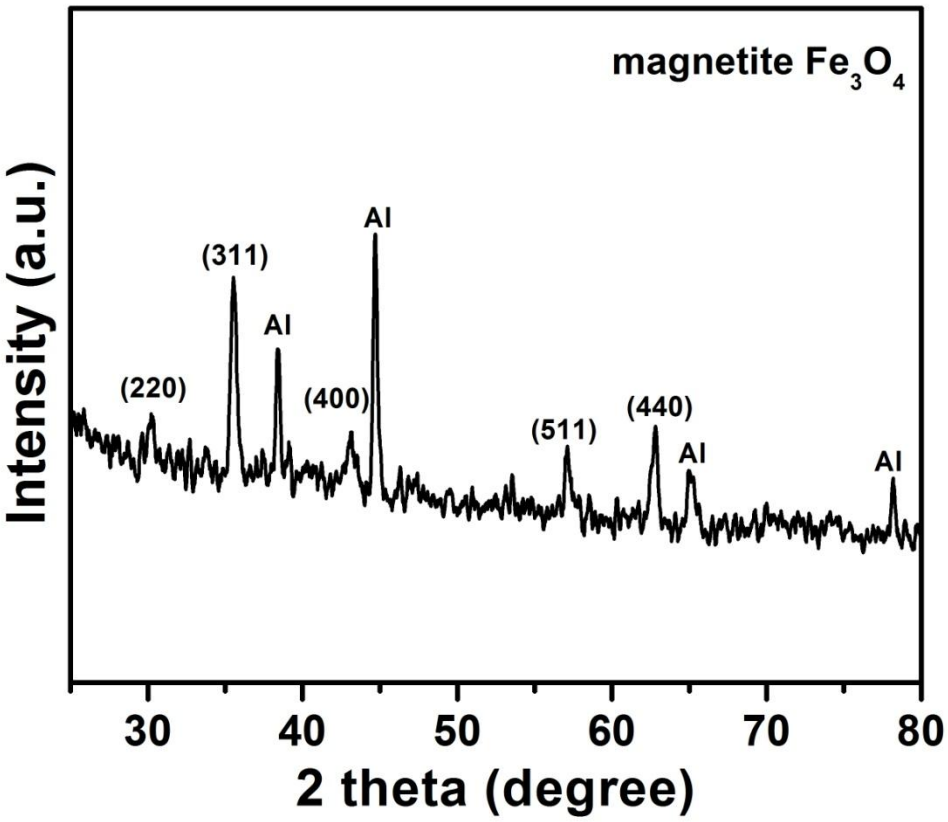

Figure S2. XRD spectra for the as-dried bacteria.

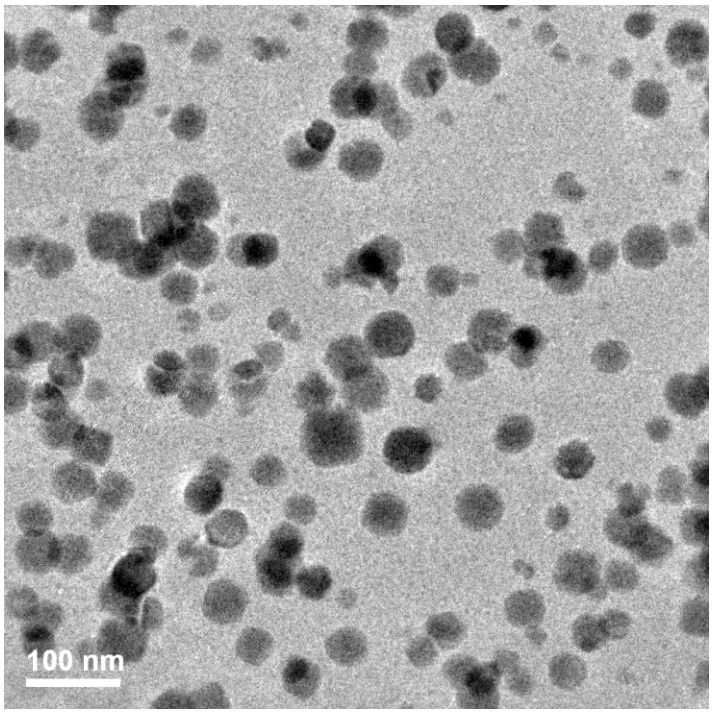

Figure S3. TEM image of M.g. bacteria annealed at 100 ^{o}C without the addition of glucose.

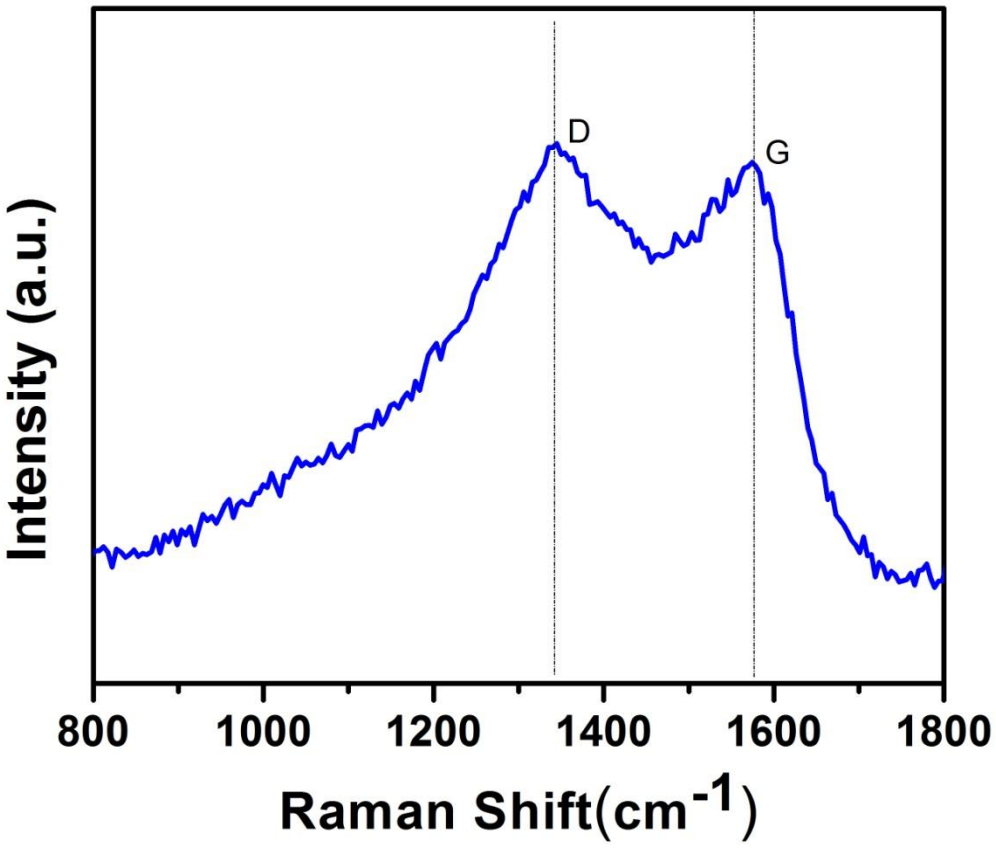

Figure S4. The Raman spectra of the annealed Fe_3O_4/C chains

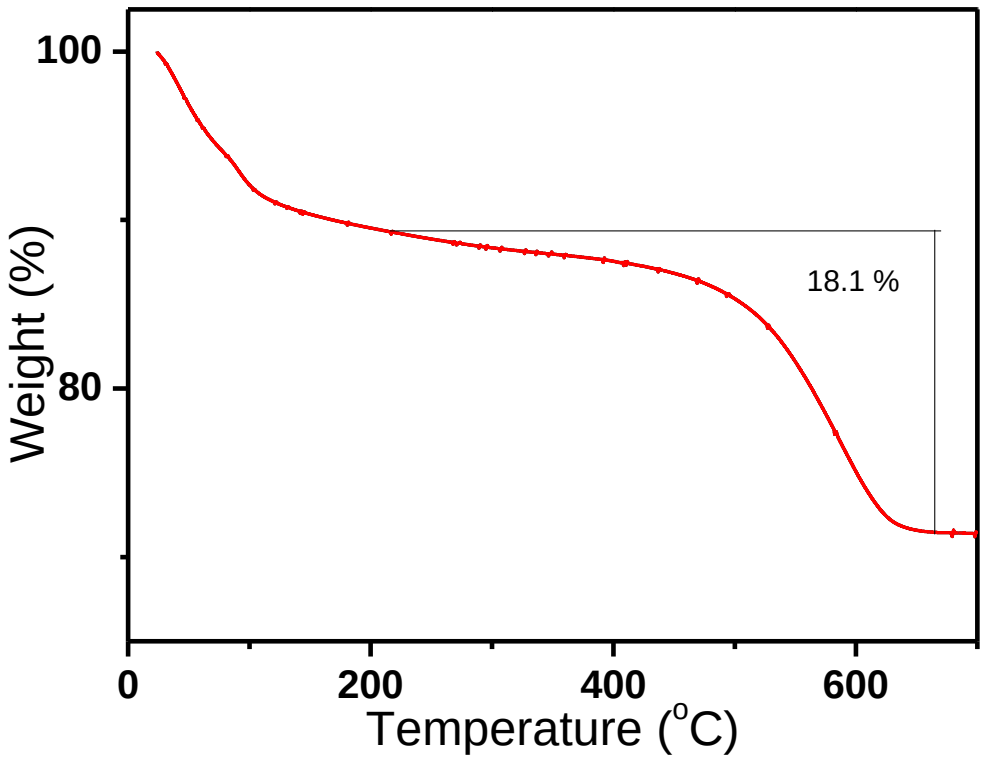

Figure S5. TGA analysis profile for the Fe_3O_4/C chains

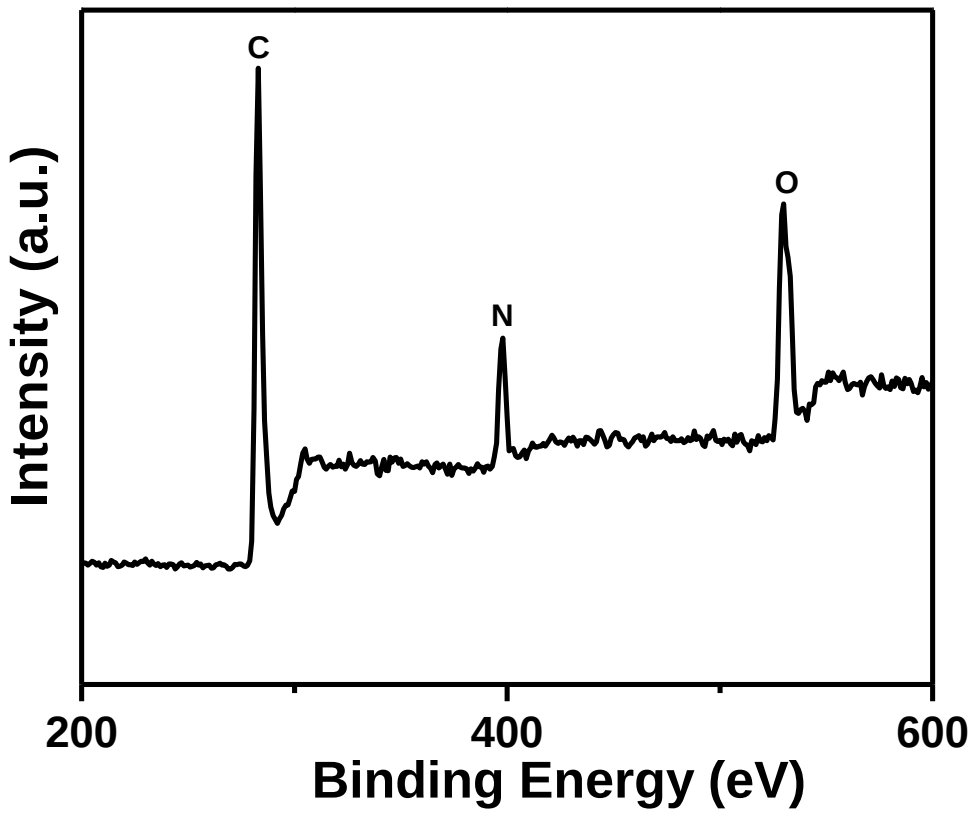

Figure S6. The XPS profile for the annealed Fe_3O_4/C chains.

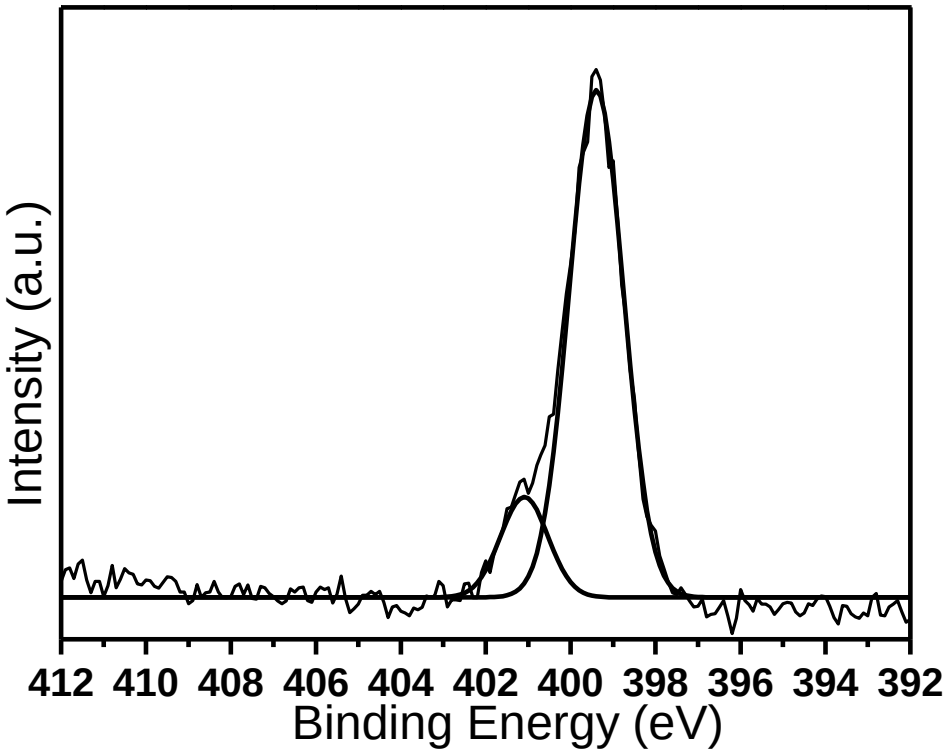

Figure S7. N1s spectra for the as-cultivated bacteria.

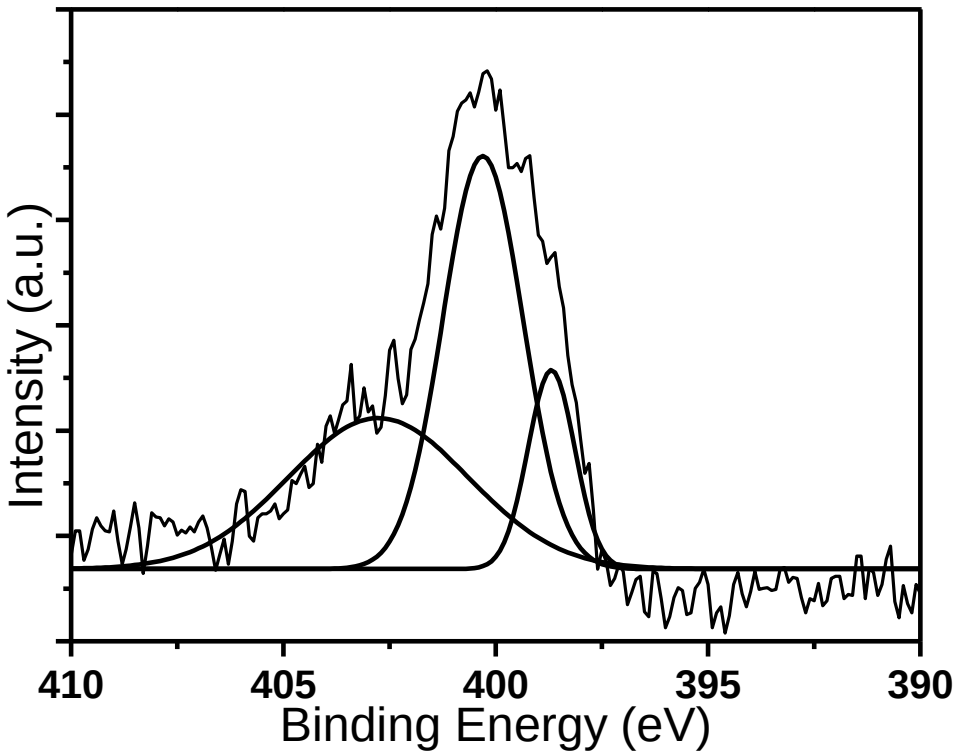

Figure S8. N1s spectra for the Fe_3O_4/C chains.

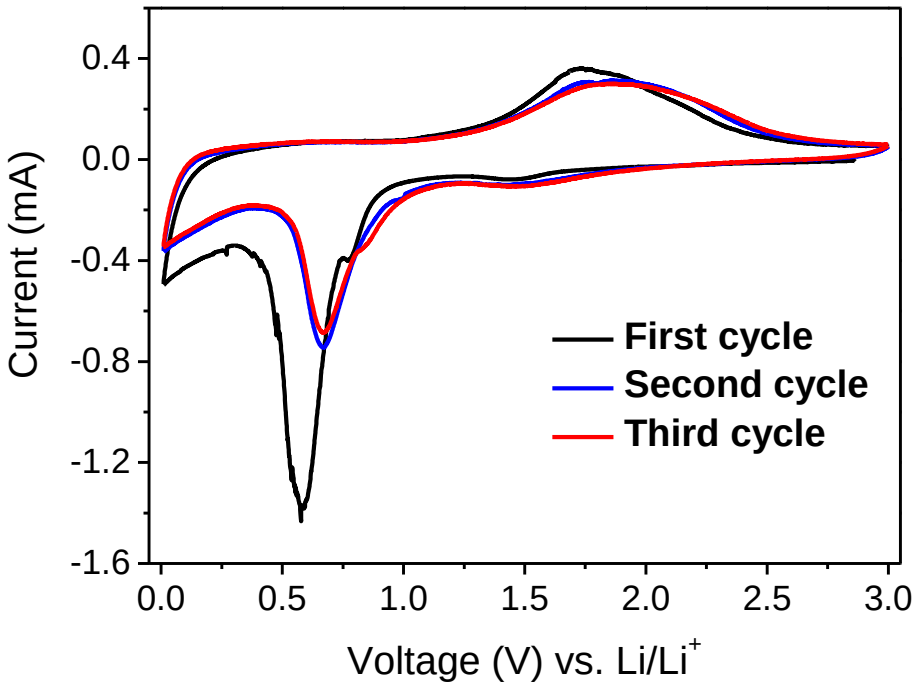

Figure S9. Cyclic voltammograms of Fe_3O_4/C chains at a scan rate of 0.1 mV s^{-1}.

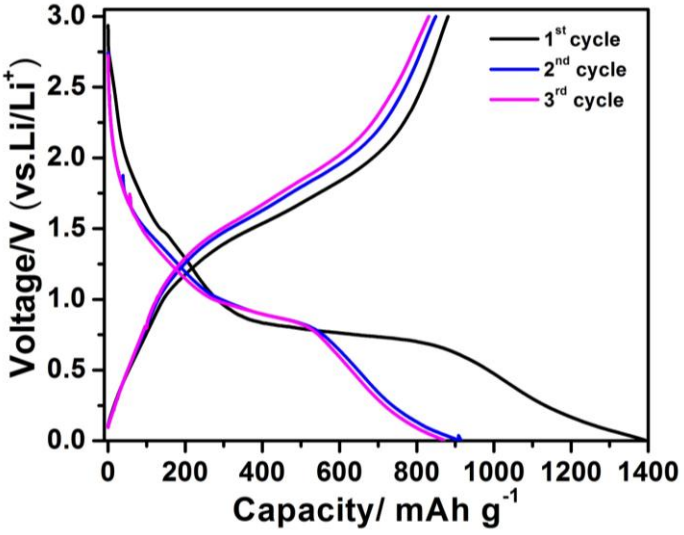

Figure S10. Charge/discharge curves at a current density of 185.2 mA g^{-1} for the first three cycles.

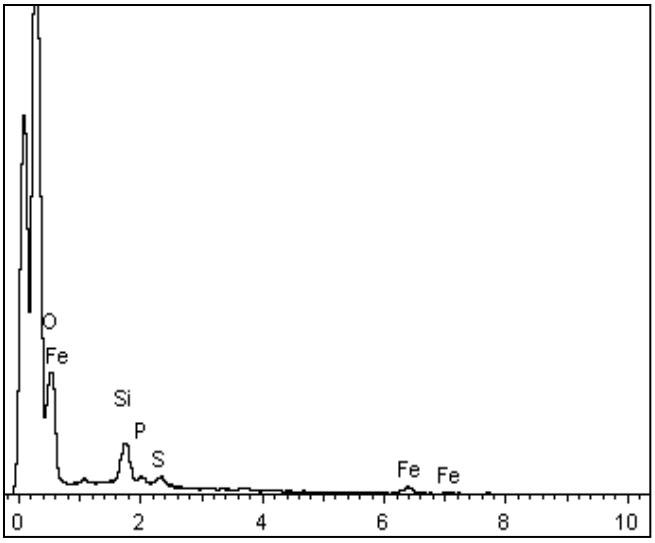

Figure S11: The EDS spectra for the as-cultivated bacteria.