Supplementary Materials

Text S1: Detailed steps of high-throughput sequencing

Microbial genomic DNA was extracted using the QIAamp DNA Stool Mini Kit (QIAGEN, Germany) strictly following the manufacturer's instructions. The V3-V4 hypervariable region of the bacterial 16S rRNA gene was amplified by polymerase chain reaction (PCR) with the primers 338F (5′-ACTCCTACGGGAGGCAGCAG-3′) and 806R (5′-GGACTACHVGGTWTCTAAT-3′). The PCR reaction mixture (25 μL) contained: 5 μL of 5× reaction buffer, 5 μL of 5× GC buffer, 0.8 μL of each primer (5 μM), 0.4 μL of 50X ROX reference Dye 1, 2 μL of DNA template, and 6 μL of ddH_2O. Amplification was performed on an ABI 9700 thermocycler (Applied Biosystems, USA) under the following program: initial denaturation at 95°C for 5 min; 35 cycles of denaturation at 95°C for 30 s, annealing at 58°C for 30 s, and extension at 72°C for 1 min; followed by a final extension at 72°C for 10 min and a hold at 10°C. For each sample, three parallel PCR amplifications were performed and their products were pooled in equal amounts. The amplified products were checked for purity on 2% agarose gels. The target bands were excised and purified using the AxyPrep DNA Gel Extraction Kit (AXYGEN, USA), followed by elution with Tris-HCl buffer. The purified products were verified again by 2% agarose gel electrophoresis and quantified preliminarily based on band intensity. Precise quantification was then achieved using the QuantiFluor™-ST system (Promega, USA). Finally, equimolar amounts of the purified PCR products from each sample were combined to construct the sequencing library according to the Illumina platform requirements.

Table S1 Main elements of iron scraps used in the experiment (wt %)

Element	Fe	C	Mn	P	S	Ti	Others
Content (%)	96.38	2.89	0.21	0.13	0.06	0.05	0.28

Table S2 Physiochemical properties of biochar, activated carbon

Parameters	Biochar	Activated carbon
C (%)	68.23	88.47
H (%)	1.67	0.82
N (%)	0.63	0.48
S (%)	0.42	0.22
O (%)	29.05	10.01
Surface area ($m^2 g^{-1}$)	62.18	405.61
Electronic conductivity ($\mu S\ cm^{-1}$)	8.35±0.62	182.23±5.76

Table S3. Mass loss of iron scraps and carbon materials

Samples	m_{Fe}	Δm_{Fe}	Δm_C	$\Delta m_{Fe}/m_{Fe}$
CW-Fe	40.01	0.10	-	0.25
CW-FeAC	40.00	0.39	0.22	0.97
CW-FeBC	40.02	0.18	0.59	0.45

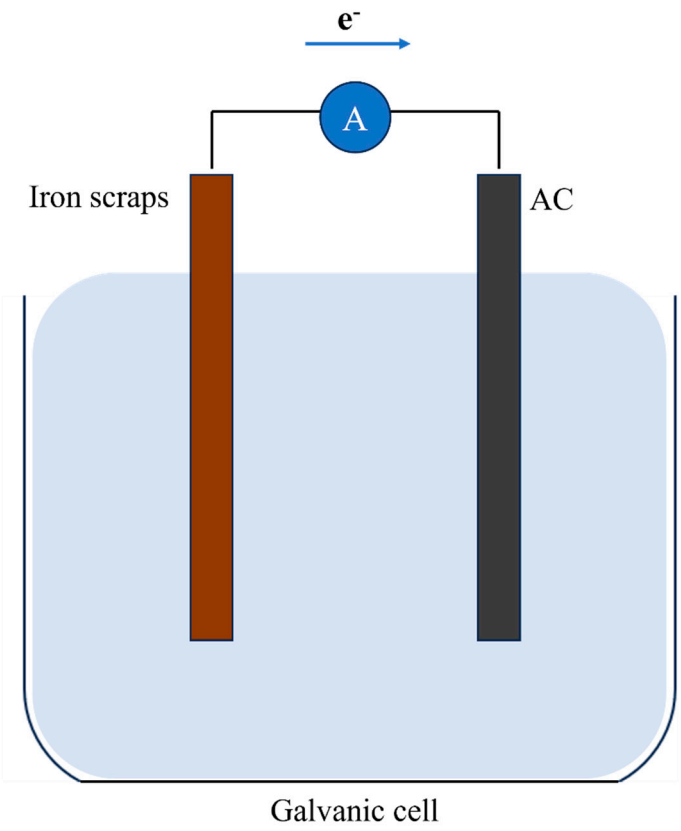

Figure S1. A schematic of galvanic cell



Iron scraps Biochar Activated carbon

Figure S2. Pictures of iron scraps and carbon materials



Figure S3. Differences in the functional composition of microorganisms in different CWs