Electronic Supplementary Information (ESI):

Electrochemical quantification of sulfamethoxazole antibiotic in environmental water using zeolitic imidazolate framework (ZIF)-derived single-atom cobalt catalyst in nitrogen-doped carbon nanostructures

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Contents:

1. Instruments for characterization

Scanning electron microscopy (SEM) images were recorded using a JSM-7600F field-emitting scanning electron microscope (JEOL, Japan). Transmission electron microscopy (TEM) images were recorded on a JEM-2100F TEM (JEOL, Japan) operating at an accelerating voltage of 200 kV. The sub-Ångström-resolution, aberration-corrected HAADF–STEM images were recorded on a JEOL JEM 2200FS STEM/TEM, equipped with a CEOS (Heidelburg, Ger) probe corrector, with a nominal image resolution of 0.07 nm. The surface characteristics of the synthesized materials were examined by X-ray photoelectron spectroscopy (XPS), which was measured with an ESCALAB 250 XPS spectrometer (VG Scientifics) using a monochromatic Al Kα line at 1486.6 eV. Binding energies were calibrated with respect to the C 1s peak at 284.6 eV. Peak fit analysis was performed using the XPS PEAK program (version 4.0). Raman spectra were recorded on a Labram HR 800 microspectrometer (Jobin Yvon, France) with an excitation source of 532 nm. Typically, Raman spectra were acquired from an area of 1 mm × 1 mm on the substrate. The collection time of each Raman spectrum was 10 s. XRD patterns were recorded on a Rigaku/Max-3A X-ray diffractometer with Cu Kα radiation (λ = 0.15418 nm).

2. HPLC analysis of SMX in water samples

HPLC analysis was carried out with an HPLC system of Shimadzu's VP-ODS (Shimadzu Corporation, Japan) with a C18 column (150 mm × 4.6 mm × 5 μm) with temperature of HPLC column at 27 °C. The mobile phase was consisted of an aqueous phase (0.075 mol/L sodium acetate, 0.035 mol/L calcium chloride, and 0.025 mol/L sodium EDTA at pH 7.0) and an organic phase (methanol and acetonitrile under the volume ratio of 75:25). Gradient elution of 90:10 aqueous phase: organic phase to 50:50 aqueous phase: organic phase (0–30 min) then to 90:10 aqueous phase: organic phase (30–35 min) was used. The flow rate was adjusted at 0.8 mL/min. Quantitative measurements were carried out by selecting the appropriate detection wavelength to attain maximum sensitivity. Therefore, the quantification was performed through internal standardization at 311 nm.

3. Figures

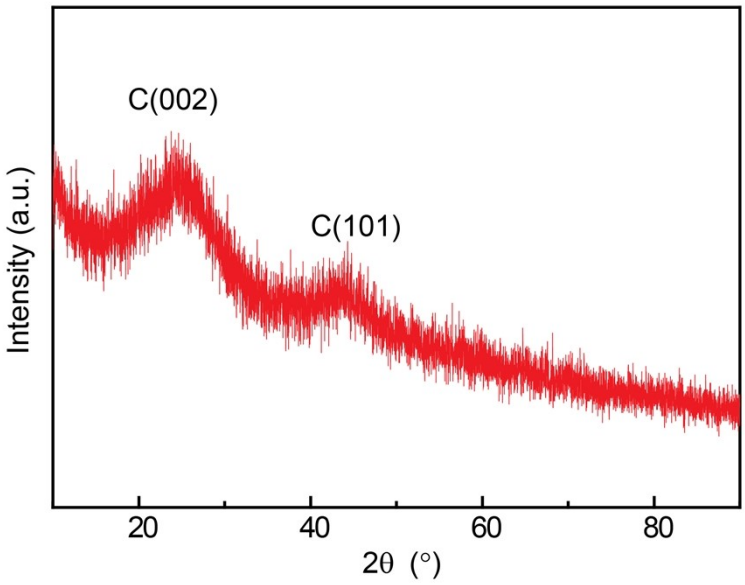

Fig. S1 XRD pattern of the Co/N–C SACs.

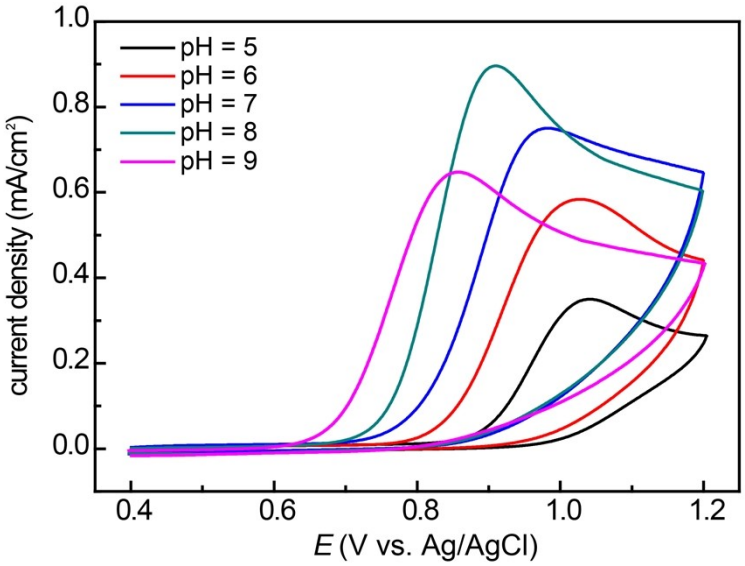

Fig. S2 CV responses of the SMX (50 μM) at the Co/N–C/GC electrode in 0.1 M PBS at various pH values. The scanning rate is 50 mV/s.

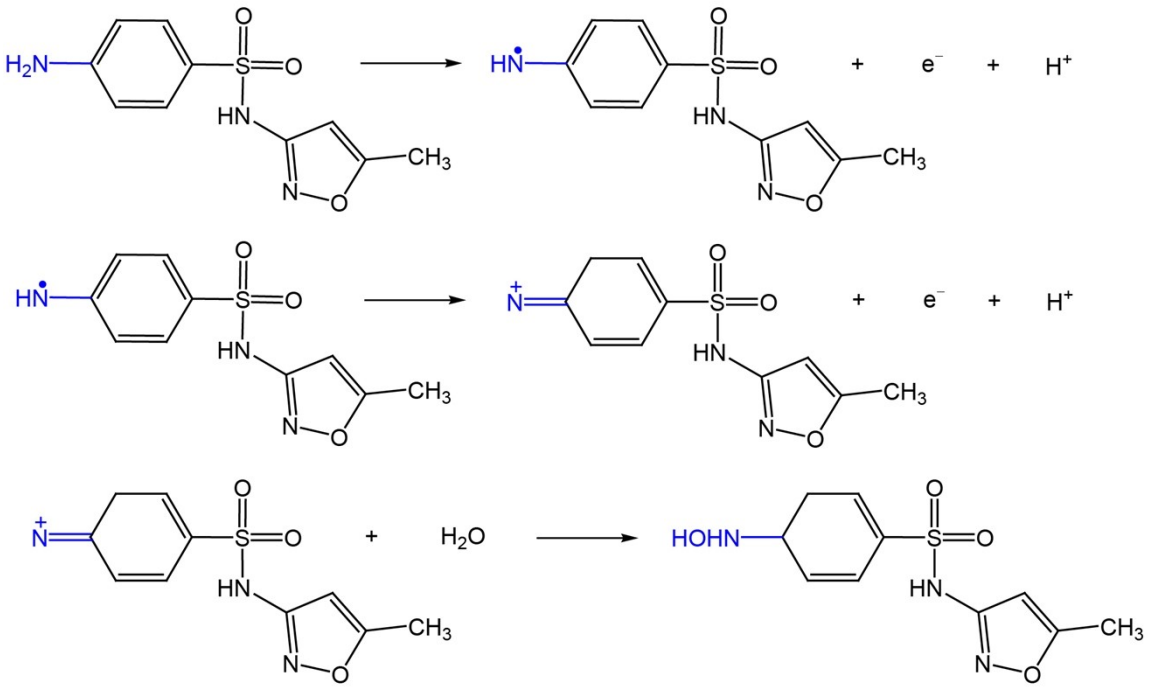

Fig. S3 The electron transfer of the oxidation of the –NH_2 group in SMX to –NHOH group over Co/N–C/GC electrode.

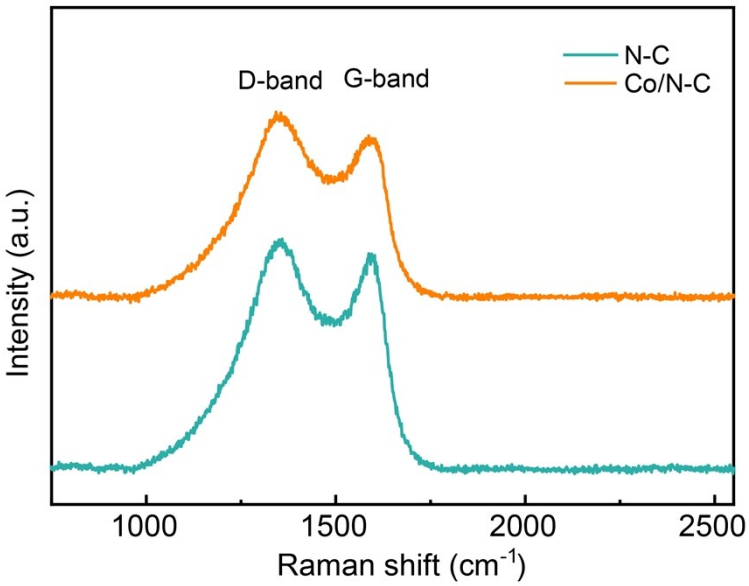

Fig. S4 Raman spectra of Co/N–C and N–C.

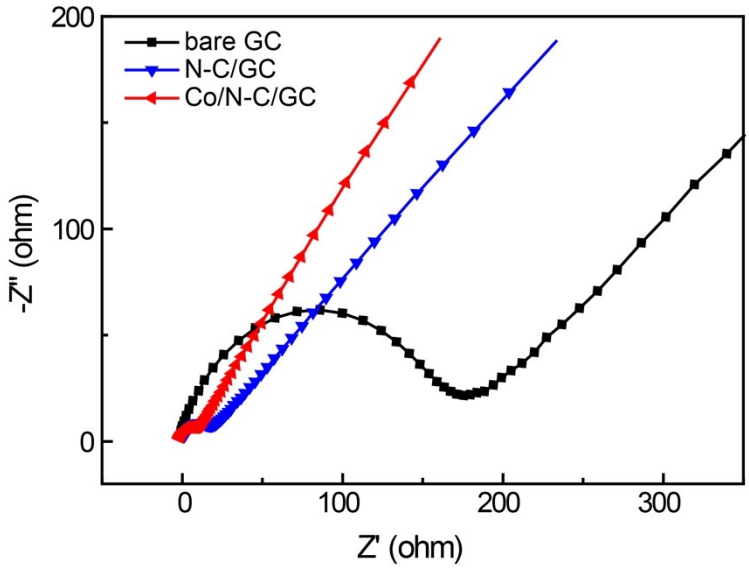

Fig. S5 Nyquist plots of the bare GC, Co/N–C/GC, and N–C/GC electrodes in 0.1 M KCl solution containing 5 mM $K_3Fe(CN)_6/K_4Fe(CN)_6$ (1:1) in the frequency range from 0.1 Hz to 100 kHz. Amplitude: 10 mV.

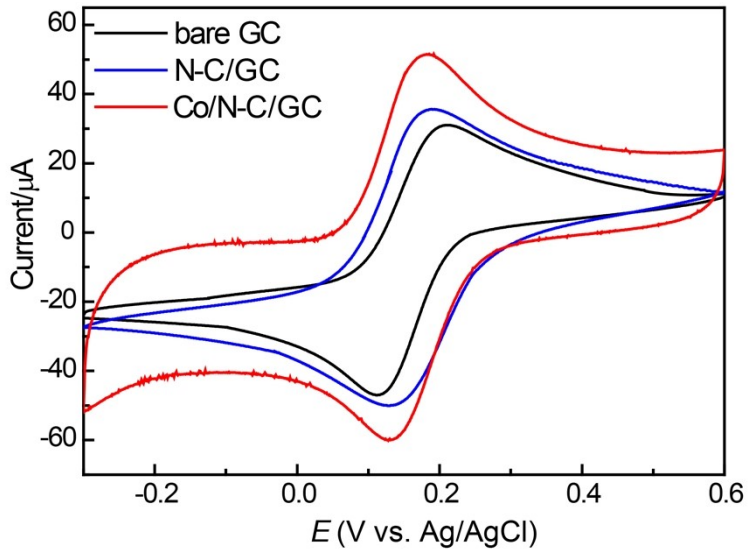

Fig. S6 CV responses of the bare GC, Co/N–C/GC, and N–C/GC electrodes in 1 M KCl solution containing 1.0 mM $K_3Fe(CN)_6$. Scan rate: 100 mV/s.

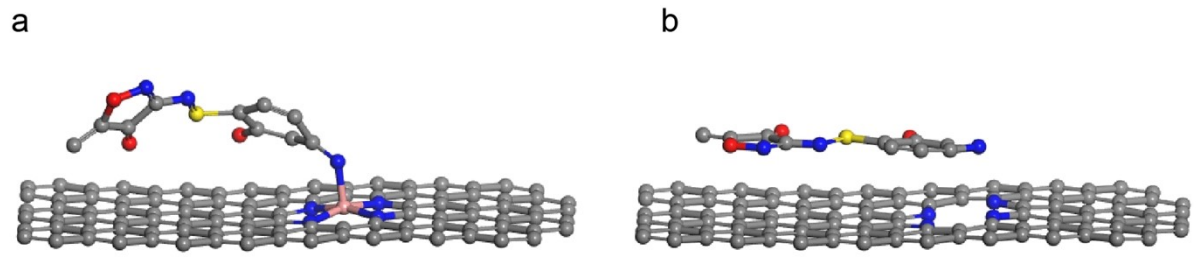

Fig. S7 Optimized configurations of SMX adsorbed on Co/N–C (a), and N–C (b). Atomic color code: gray, carbon; red, oxygen; blue, nitrogen; and yellow, sulfur.

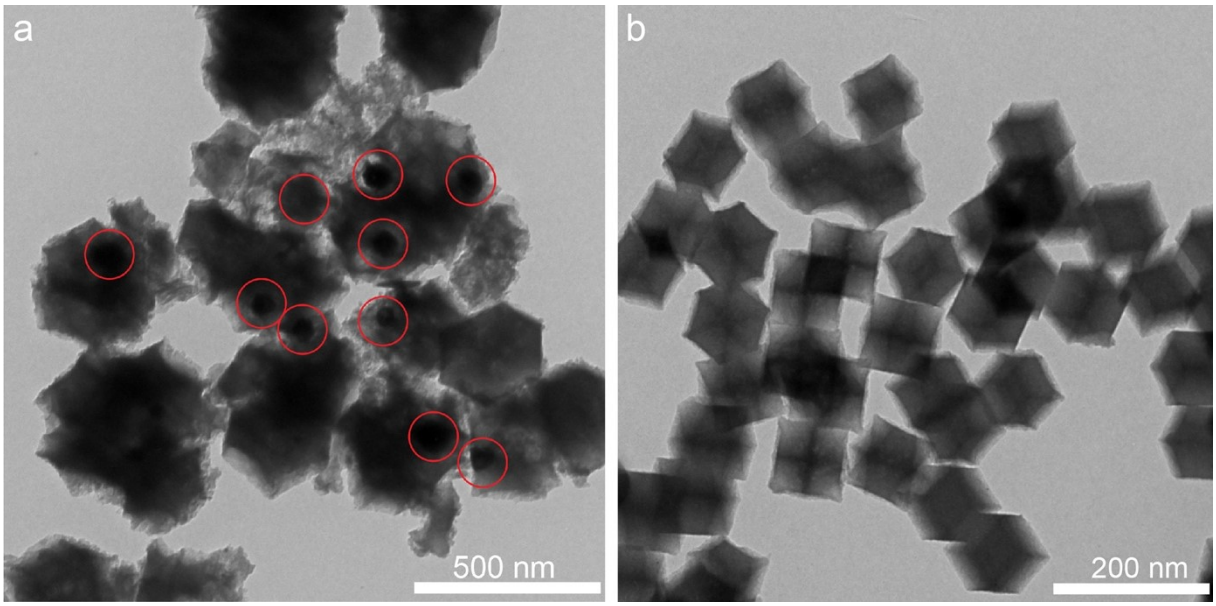

Fig. S8 TEM image of the Co/N–C SACs synthesized with Co:Zn ratio of 0.75:1 (a) and 0.25:1 (b).