Supplementary Material for

A collaborative strategy for elevated reduction of Cr(VI) through pyrolyzed graphite-based biosynthetic Schwertmannite composite catalyzed by oxalic acid

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Table S1 The component of 9K medium

Content	Concentration (g L^{-1})
$(NH_4)_2SO_4$	3.0
KCl	0.1
$K_2HPO_4 \cdot 3H_2O$	0.5
$MgSO_4 \cdot 7H_2O$	0.5
$Ca(NO_3)_2 \cdot 4H_2O$	0.01
$FeSO_4 \cdot 7H_2O$	44.7

Table S2 Chemicals and reagents

Chemical	Purity	Supplier
$K_3[Fe(CN)_6]$	Analytical	Aladdin Chemical Reagent Co., Ltd (Shanghai)
$K_2Cr_2O_7$	Analytical	Sinopharm Chemical Reagent Co., Ltd
$H_2C_2O_4$	Analytical	Sinopharm Chemical Reagent Co., Ltd
Na_2SO_4	Analytical	Sinopharm Chemical Reagent Co., Ltd
$(NH_4)_2SO_4$	Analytical	Sinopharm Chemical Reagent Co., Ltd
$NaNO_3$	Analytical	Sinopharm Chemical Reagent Co., Ltd
KNO_3	Analytical	Sinopharm Chemical Reagent Co., Ltd
$Ca(NO_3)_2$	Analytical	Sinopharm Chemical Reagent Co., Ltd
NaCl	Analytical	Sinopharm Chemical Reagent Co., Ltd
KCl	Analytical	Sinopharm Chemical Reagent Co., Ltd
$NaHCO_3$	Analytical	Sinopharm Chemical Reagent Co., Ltd

K_2HPO_4	Analytical	Sinopharm Chemical Reagent Co., Ltd
NaH_2PO_4	Analytical	Sinopharm Chemical Reagent Co., Ltd
$FeSO_4·7H_2O$	Analytical	Sinopharm Chemical Reagent Co., Ltd
$MgSO_4·7H_2O$	Analytical	Sinopharm Chemical Reagent Co., Ltd
NaOH	Analytical	Sinopharm Chemical Reagent Co., Ltd
H_2SO_4	Analytical	Sinopharm Chemical Reagent Co., Ltd
HNO_3	Analytical	Sinopharm Chemical Reagent Co., Ltd
H_3PO_4	Analytical	Sinopharm Chemical Reagent Co., Ltd

Table S3 Electrochemical measurements

Measurement	Parameters	Electrolyte composition
Cyclic voltammetry (CV)	Voltage range: -1.5 to 0.2 V Scan rate: 0.05 V/s	20 mg/L Cr(VI) 1 mmol/L oxalic acid 0.1 M KNO_3
Open-circuit potential (OCPT)	Detection time: 1800 s	20 mg/L Cr(VI) 1 mmol/L oxalic acid 0.1 M KNO_3
Tafel curve	Scan rate: 0.01 V/s	20 mg/L Cr(VI) 1 mmol/L oxalic acid 0.1 M KNO_3
Electrochemical impedance spectroscopy (EIS)	Frequency range: 0.01–10^5 Hz	5 mmol/L $K_3[Fe(CN)_6]$ 0.1 M KCl

Instrument: CHI760E electrochemical workstation. Working electrode: *Sch*@G composite/glassy carbon. Counter electrode: Pt. Reference electrode: $Hg/HgCl_2$

Table S4 BET analysis of different materials

Materials	Specific surface area (m^2g^{-1})	Pore volume (cm^3g^{-1})	Average pore size (nm)
Graphite 700℃	14.166	0.059	3.066
Sch 700℃	0.697	0.001	3.392
0.5-*Sch*@G 700℃	13.085	0.063	3.081
0.5-*Sch*@G 700℃ after reaction	11.394	0.050	3.082

Table S5 Peak area of different materials

Materials	S_D (cm^2)	S_G (cm^2)	I_D/I_G
Graphite 700℃	6590.4081	9085.8959	0.7253
0.25-*Sch*@G 700℃	5860.0738	9852.9099	0.5948
0.5-*Sch*@G 700℃	4471.8802	8853.2977	0.5051
0.75-*Sch*@G 700℃	4740.6126	7493.1438	0.6327
1.0-*Sch*@G 700℃	3926.0546	7085.2554	0.5562
0.5-*Sch*@G 500℃	2675.5747	6923.6887	0.3864
0.5-*Sch*@G 900℃	5321.0633	5678.0524	0.9371

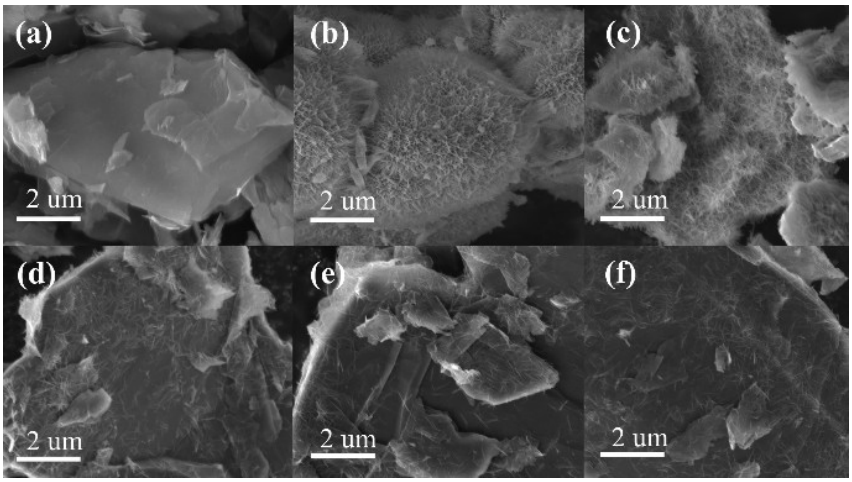

Figure S1 SEM images of (a) Graphite, (b) *Sch*, (c) 0.25-*Sch*@G, (d) 0.5-*Sch*@G, (e) 0.75-*Sch*@G and (f) 1.0-*Sch*@G

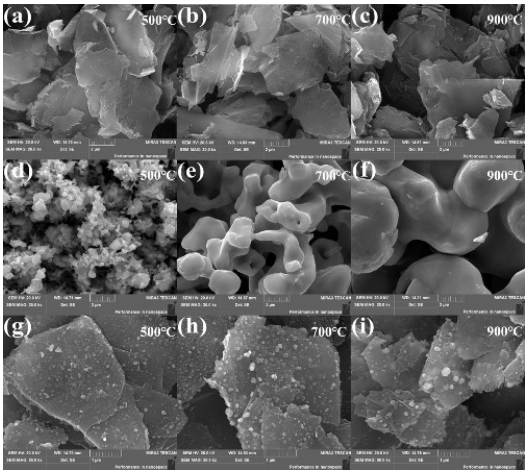

Figure S2 SEM images of (a-c) Graphite, (d-f) *Sch* and (g-i) 0.5-*Sch*@G after pyrolyzed at different 500℃, 700℃, 900℃

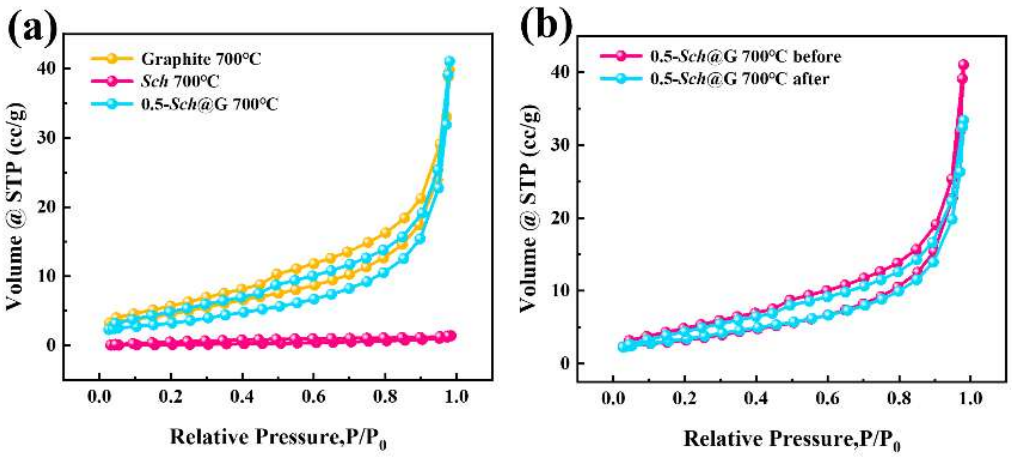

Figure S3 N_2 adsorption-desorption isotherms of (a) materials after pyrolysis and (b) 0.5-*Sch*@G 700°C before and after reaction

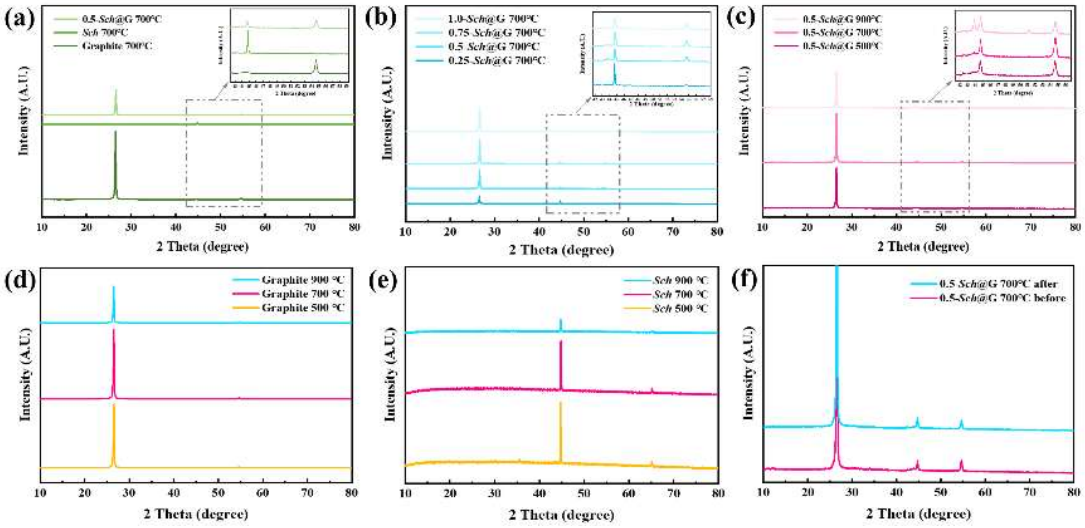

Figure S4 XRD patterns of (a) different materials after pyrolysis at 700℃, (b) *Sch*@G with different graphite additions, (c) 0.5-*Sch*@G at different pyrolysis temperatures, (d) graphite at different pyrolysis temperatures, (e) *Sch* at different pyrolysis temperatures and (f) 0.5-*Sch*@G 700℃ before and after reaction

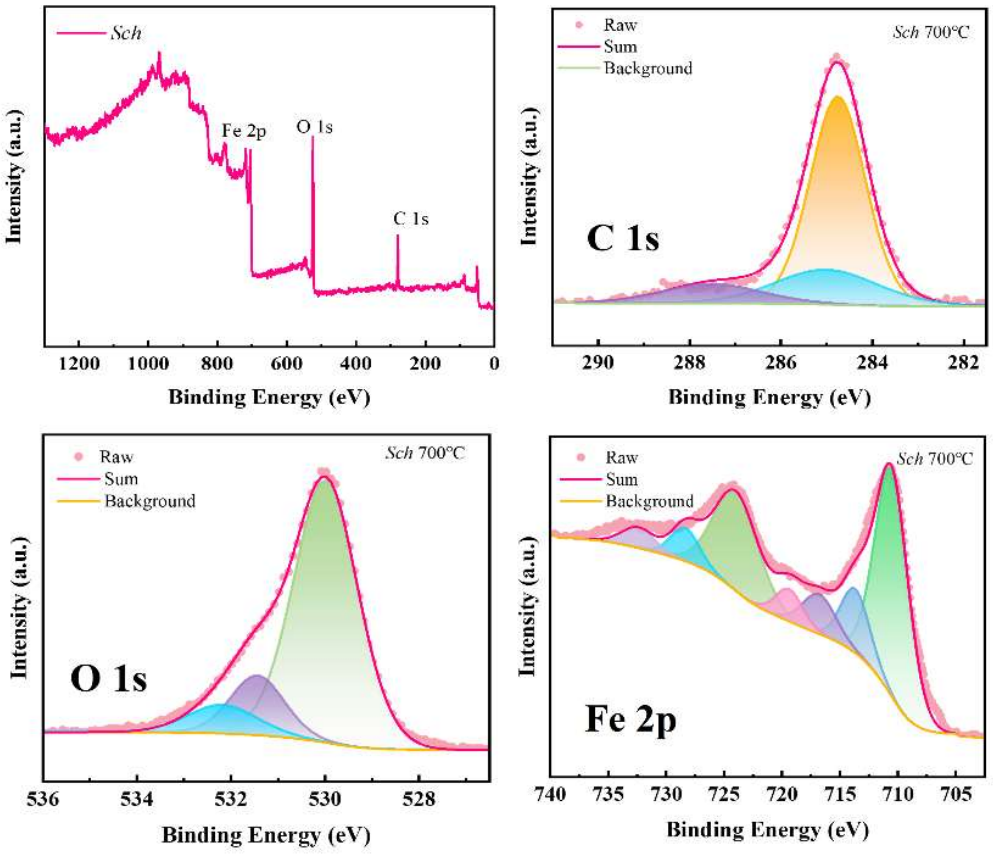

Figure S5 (a) XPS survey spectra and high-resolution (b) C 1s, (c) O 1s, and (d) Fe 2p XPS spectra of *Sch*

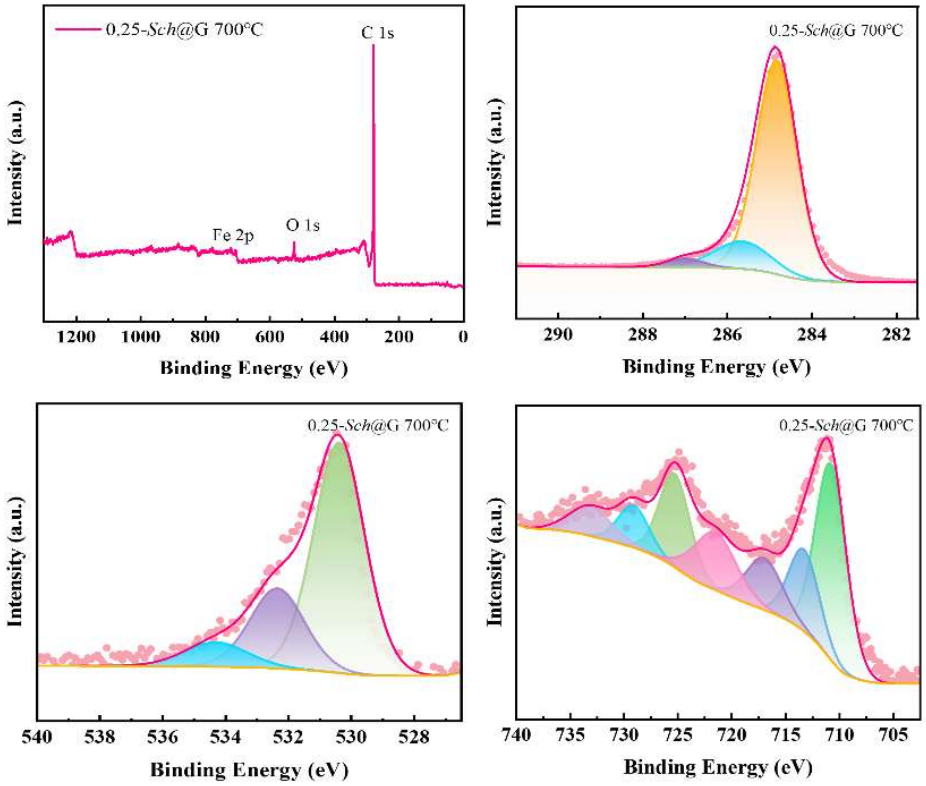

Figure S6 (a) XPS survey spectra and high-resolution (b) C 1s, (c) O 1s, and (d) Fe 2p XPS spectra of 0.25-*Sch*@G 700°C

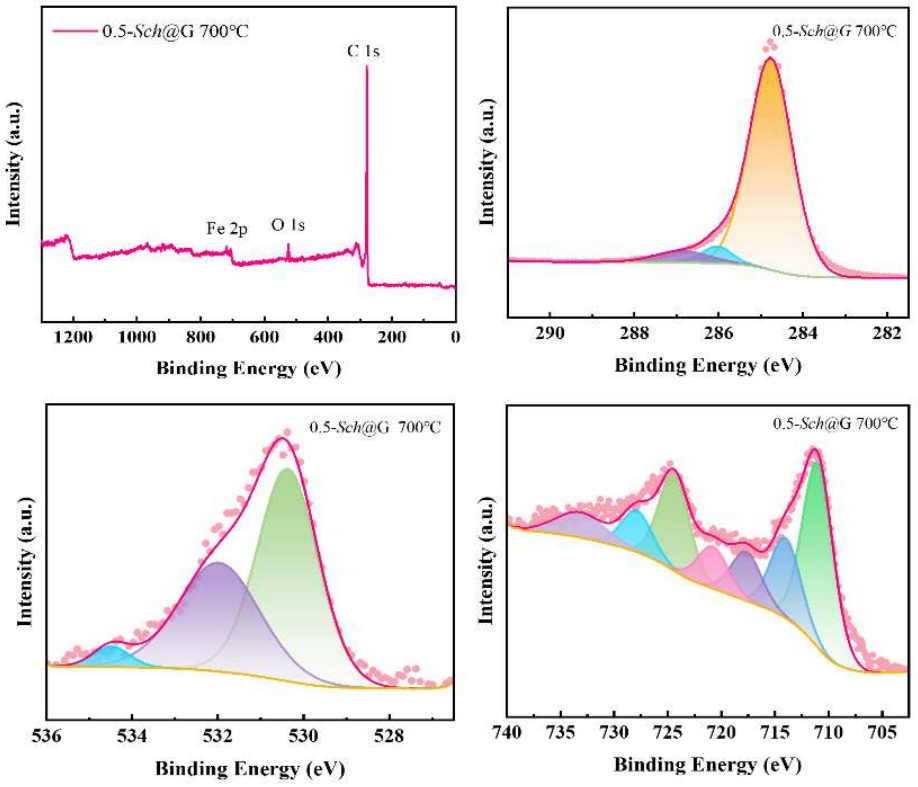

Figure S7 (a) XPS survey spectra and high-resolution (b) C 1s, (c) O 1s, and (d) Fe 2p XPS spectra of 0.5-*Sch*@G 700°C

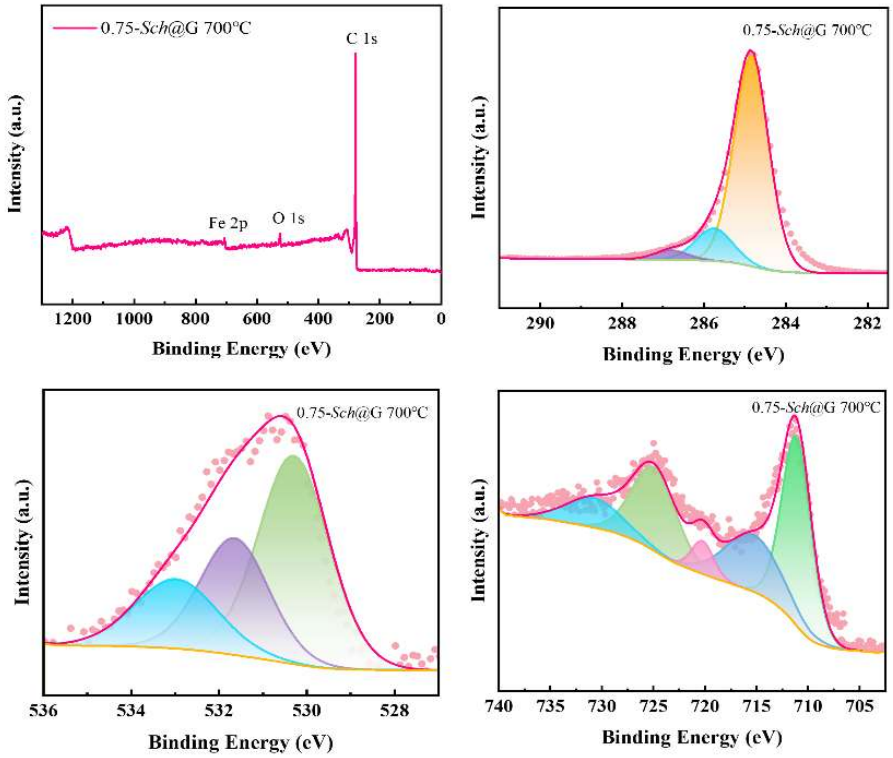

Figure S8 (a) XPS survey spectra and high-resolution (b) C 1s, (c) O 1s, and (d) Fe 2p XPS spectra of 0.75-*Sch*@G 700°C

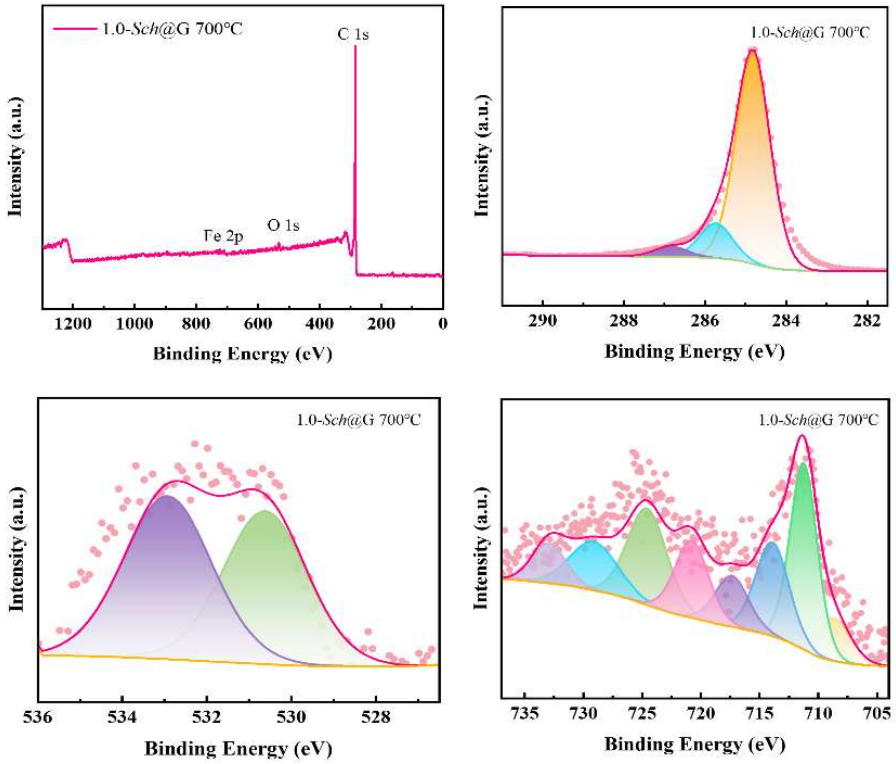

Figure S9 (a) XPS survey spectra and high-resolution (b) C 1s, (c) O 1s, and (d) Fe 2p XPS spectra of 1.0-*Sch*@G 700°C

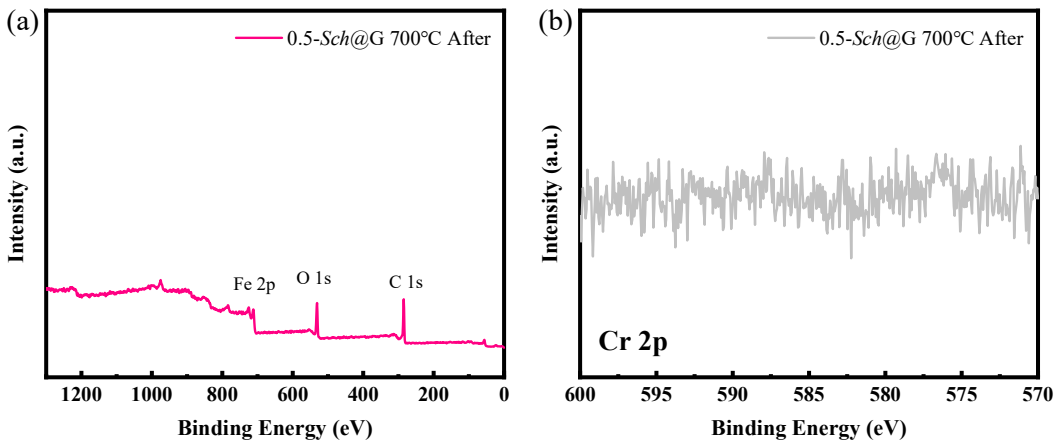

Figure S10 (a) XPS survey spectra and high-resolution (b) Cr 2p XPS spectra of 0.5-*Sch*@G 700℃ after reaction