

Robust Self-Supported SnO₂-Mn₂O₃@CC Electrode for Efficient Electrochemical Degradation of Cationic Blue X-GRRL Dye

Caiyun Li ¹, Peng Yi ¹, Junwei Sun ², Xi-Ao Wang ², Rongzhan Liu ^{1,3,*}, Jiankun Sun ^{2,3,*}

¹ College of Textiles and Clothing, Qingdao University, Qingdao 266071, China

² College of Chemistry and Chemical Engineering, Qingdao University, Qingdao 266071, China

³ Collaborative Innovation Center for Eco-Textiles of Shandong Province and the Ministry of Education, 308 Ningxia Road, Qingdao 266071, China

* Correspondence: lrz727602@qdu.edu.cn (R.L.); sunjk@qdu.edu.cn (J.S.)

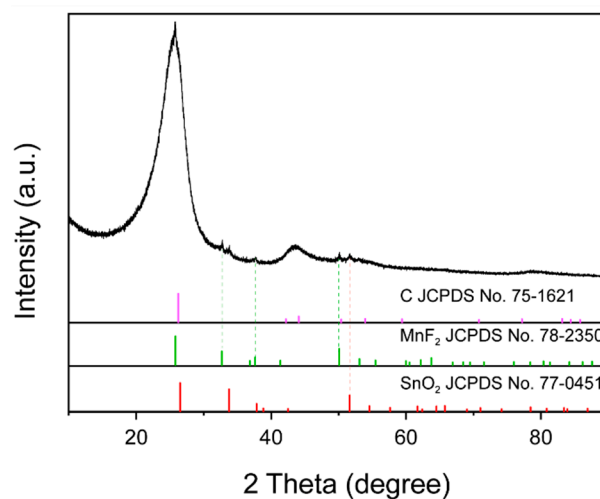


Figure S1. XRD pattern of $\text{SnO}_2\text{-Mn}_2\text{O}_3\text{@CC}$ precursor.

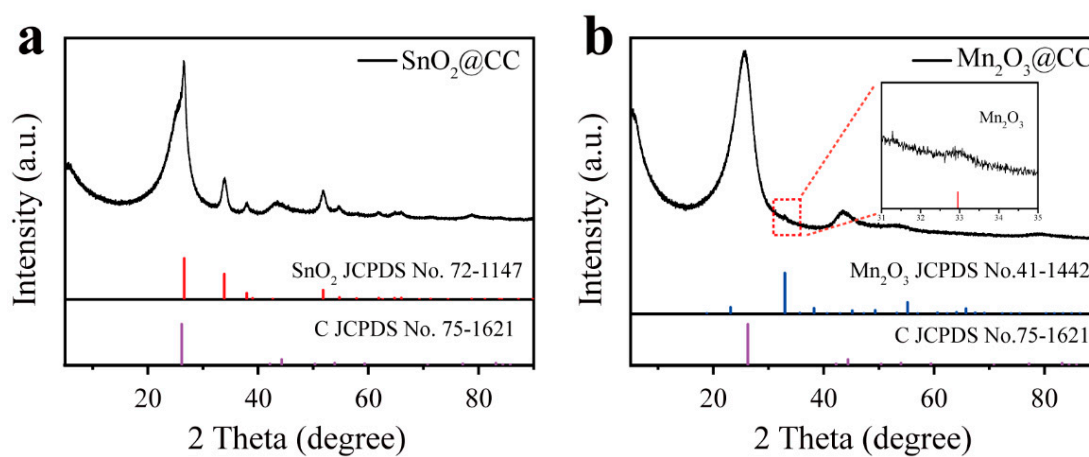


Figure S2. XRD patterns of $\text{SnO}_2\text{@CC}$ (a) and $\text{Mn}_2\text{O}_3\text{@CC}$ (b).

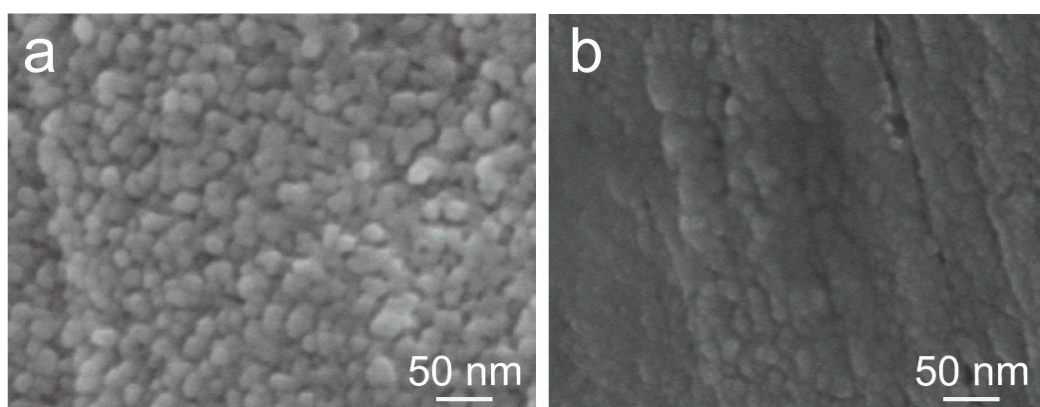


Figure S3 SEM images of $\text{Mn}_2\text{O}_3\text{@CC}$ (a) and $\text{SnO}_2\text{@CC}$ (b).

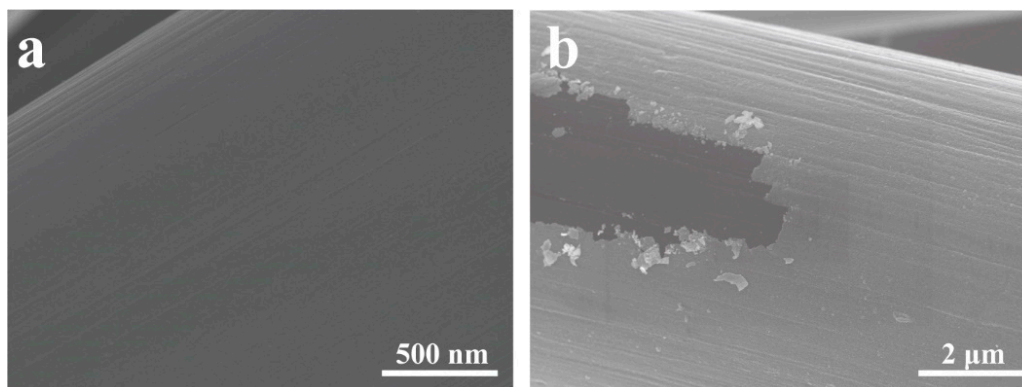


Figure S4 SEM images of carbon cloth (a) and SnO₂@CC (b).

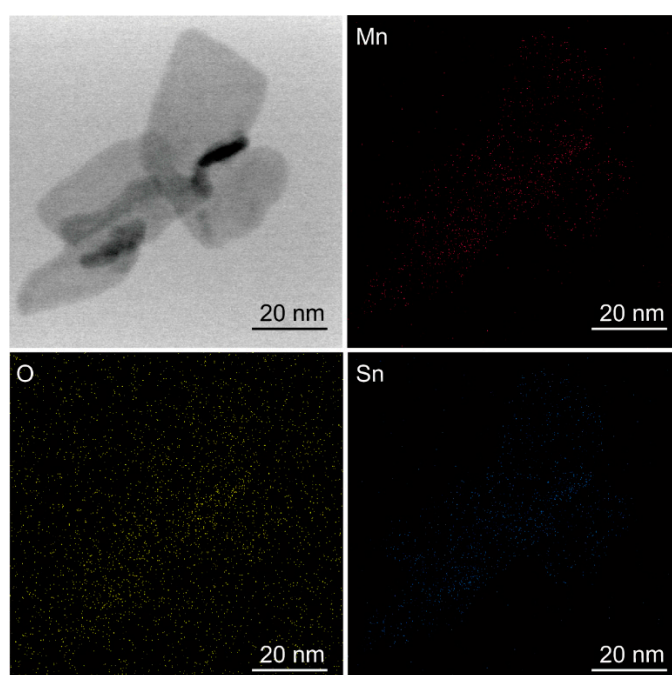


Figure S5 STEM image and corresponding EDS elemental mapping images of Sn, O, Mn.

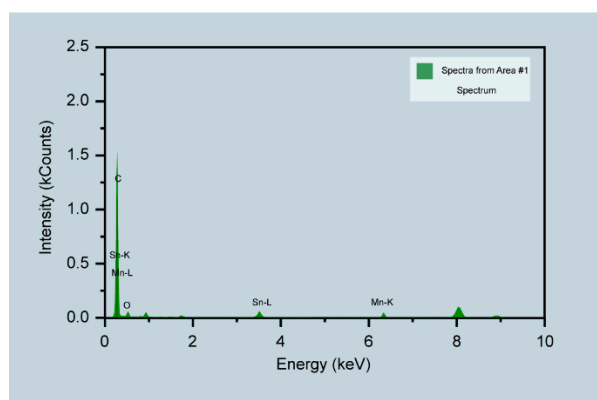


Figure S6. EDX spectrum of SnO₂-Mn₂O₃@CC.

Table S1 The elemental content in SnO₂-Mn₂O₃ hybrid nanosheets.

Element	Atomic Fraction (%)
O	66.67
Mn	0.19
Sn	0.53

Table S2 the electrical conductivity of different electrodes.

	Mn ₂ O ₃ @CC	SnO ₂ @CC	SnO ₂ -Mn ₂ O ₃ @CC
$\sigma(\text{S/m}) \cdot 10^{-4}$	5.13	6.67	9.52

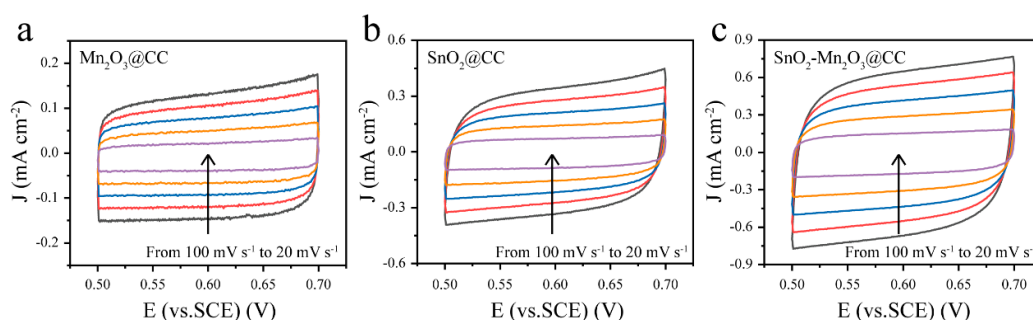


Figure S7. Cyclic voltammograms of Mn₂O₃@CC (a), SnO₂@CC (b), SnO₂-Mn₂O₃@CC (c) at the different scan rates varying from 20 to 100 mV s⁻¹ in 1M KOH.

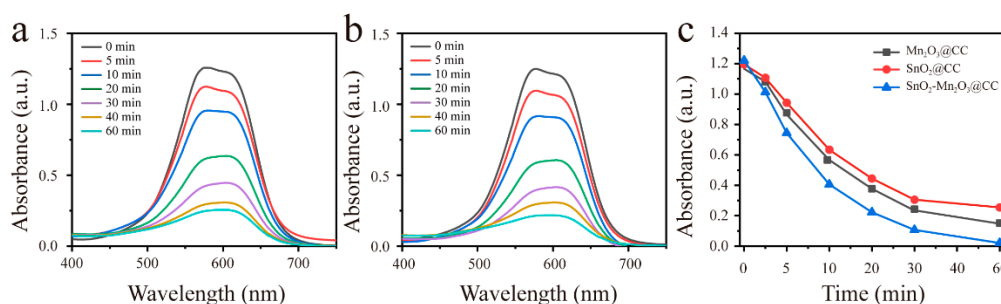


Figure S8. UV-vis absorbance spectrum of (a) Mn₂O₃@CC electrode and (b) SnO₂@CC electrode in the degradation process (initial concentration of cationic blue X-GRRL is 20 mg L⁻¹; supporting electrolyte is 0.5 M NaCl, current density is 15 mA cm⁻²). (c) The comparative intensity of time-dependent characteristic adsorption peaks of cationic blue X-GRRL on

different electrodes.

Table S3 Kinetic parameters of different electrodes for degradation of cationic blue X-GRRL.

	$K(\text{min}^{-1})$	R^2
$\text{SnO}_2\text{-Mn}_2\text{O}_3@\text{CC}$	0.07096	99.6%
$\text{SnO}_2@\text{CC}$	0.04273	99.5%
$\text{Mn}_2\text{O}_3@\text{CC}$	0.04953	99.8%

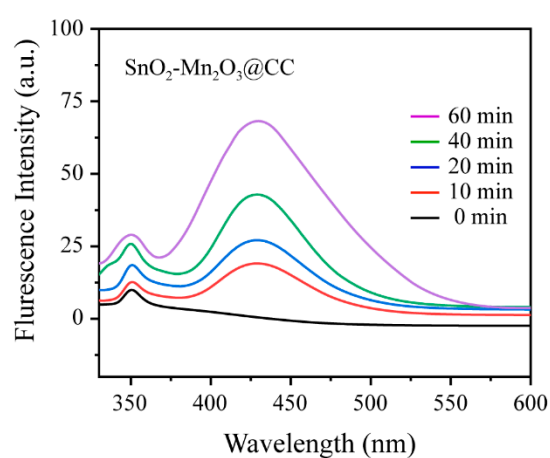


Figure S9. Variations of fluorescence intensity at different time (p-phthalic acid: 0.5 mM, NaCl: 0.5 M).

Table S4 Kinetic parameters of $\text{SnO}_2\text{-Mn}_2\text{O}_3@\text{CC}$ electrode in different electrolytes for degradation of cationic blue X-GRRL.

	$K(\text{min}^{-1})$	R^2
0.5 M NaCl	0.07096	99.6
0.5 M Na_2SO_4	0.00373	99.3
0.5 M Na_2CO_3	0.03081	98.7