

## Supplementary Data

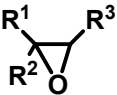
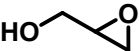
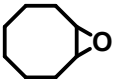
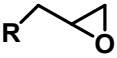
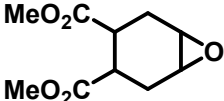
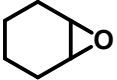
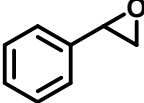
### **Bromine and Oxygen Redox Species Mediated Highly Selective Electro-Epoxidation of Styrene**

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Islam, Hira Fazal and Xuefeng Qian*

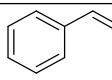
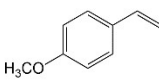
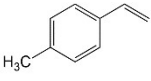
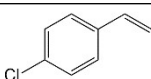
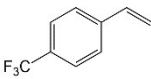
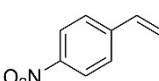
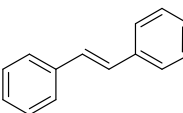
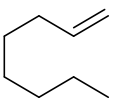
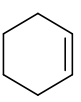
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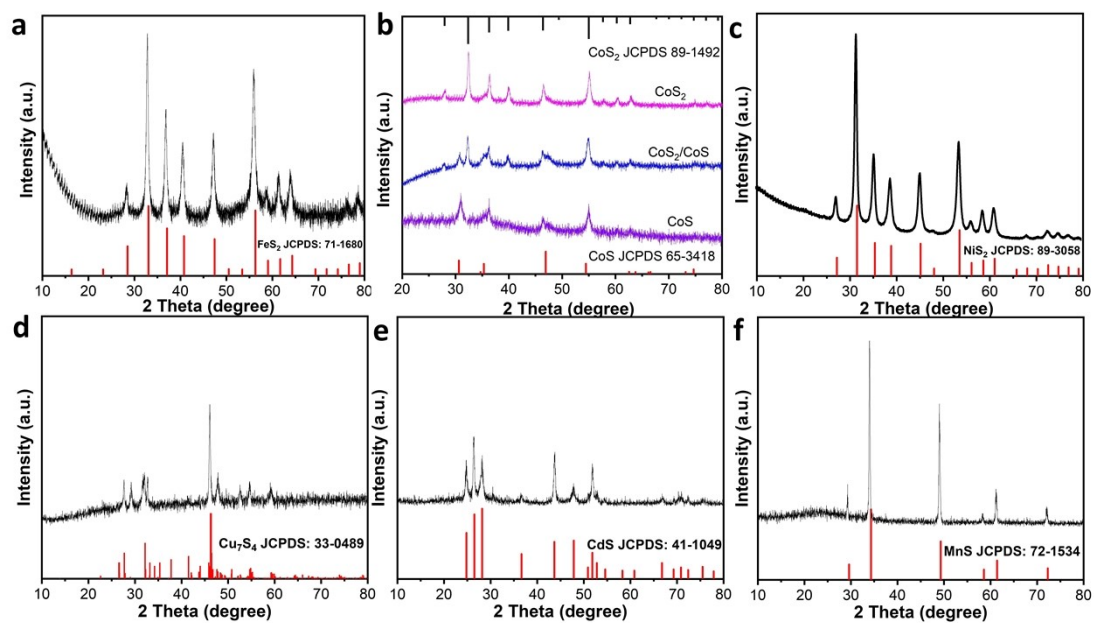
<sup>†</sup>These authors contributed equally: Yuchi Zhang, Asma Iqbal.

**Table S1** Some reported electro-epoxidation works.

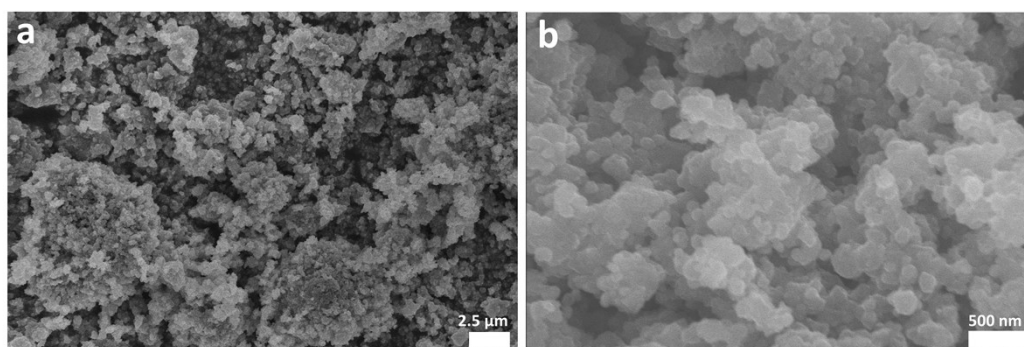
Epoxide Type	Anode/Cathode, Parameters	
	<p><b>Diamond/Pt, Na<sub>2</sub>CO<sub>3</sub>•H<sub>2</sub>O<sub>2</sub></b> Iminium salt , Constant current: 300 mA</p>	
	<p><b>Ti/Graphite</b>, in situ generated H<sub>2</sub>O<sub>2</sub>, O<sub>2</sub> Constant current: 300 mA, yield: 18.6%</p>	
	<p><b>MnO<sub>3</sub>-doped C/Pt</b>, Constant potential</p>	
	<p><b>Graphite/Graphite</b>, NaBr, Constant current, 3 mA cm<sup>-2</sup></p>	
	<p><b>Pt/Pt</b> NaBr, Constant current, 10 mA</p>	
	<p><b>Pt/Pt NaBr</b> Constant current, 350 mA</p>	<p><b>Pt or Ti/Pb</b> Constant current 4 mA cm<sup>-2</sup></p>
	<p><b>C/Fe</b> NaBr, constant current 7 mA</p>	

**Table S2** Some by-products entries for electro-epoxidation of different olefins.

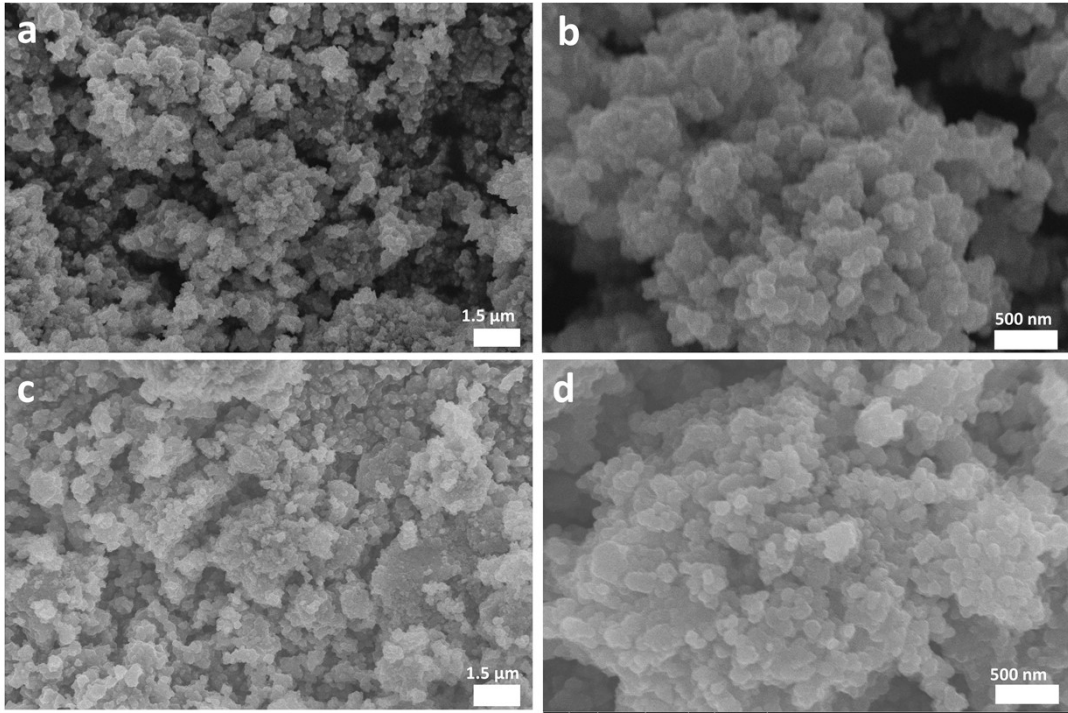
Entry	Substrate	Conversion (%)	Selectivity (%)	Diol	dibromide	bromohydrin	substituted
1		100	97	-	2	-	1 Bromo styrene
2		100	20	4	6	35	35
3		100	50	-	-	22	28 (radical)
4		80	44	12	24	-	-
5		100	70	-	-	-	30 Aldehyde
6		96	92	-	-	4	-
7		40%	99	-	-	1	-
8		100%	50	-	50	-	-
9		100%	0%	-	54	38	8 Cyclohexenol



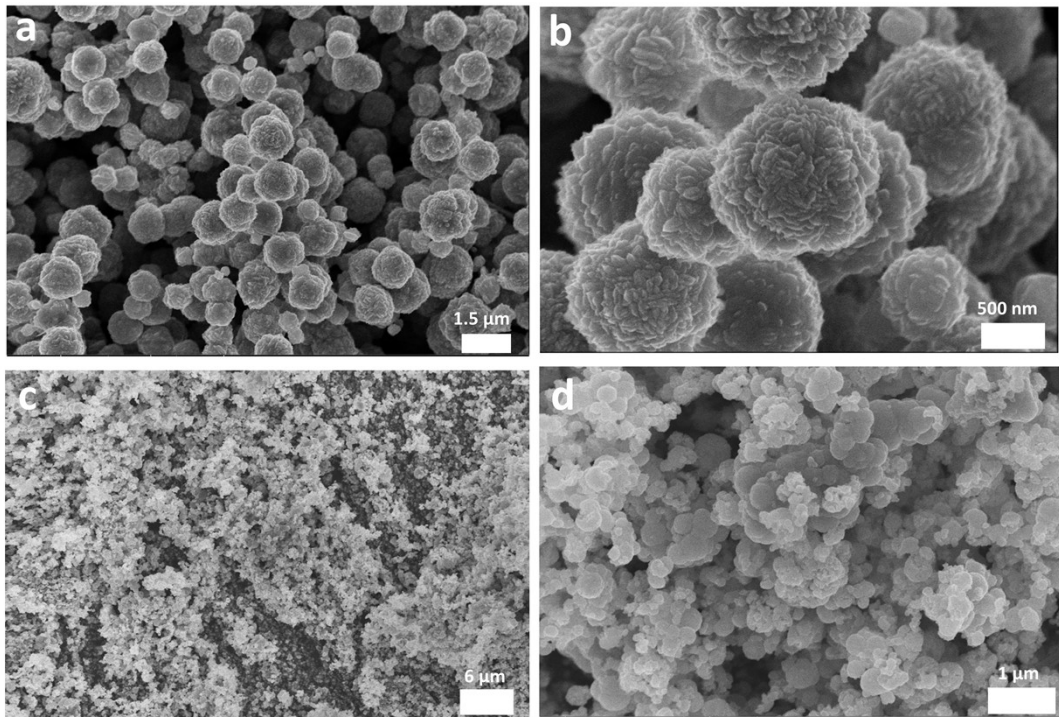
**Fig S1** XRD patterns of prepared metal sulfides and their standard patterns (a) FeS<sub>2</sub>, (b) CoS<sub>2</sub>, CoS and CoS<sub>2</sub>/CoS, (c) NiS<sub>2</sub>, (d) Cu<sub>7</sub>S<sub>4</sub>, (e) CdS, (f) MnS.



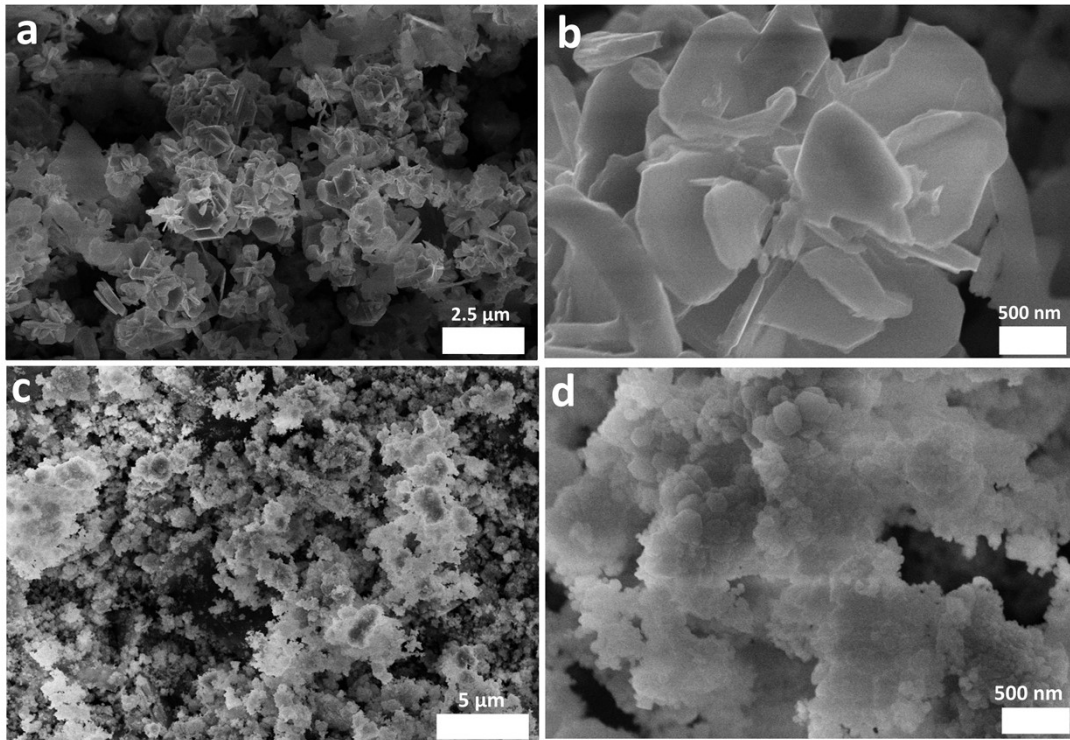
**Fig S2** SEM images of the prepared (a, b) CoS<sub>2</sub>/CoS powders.



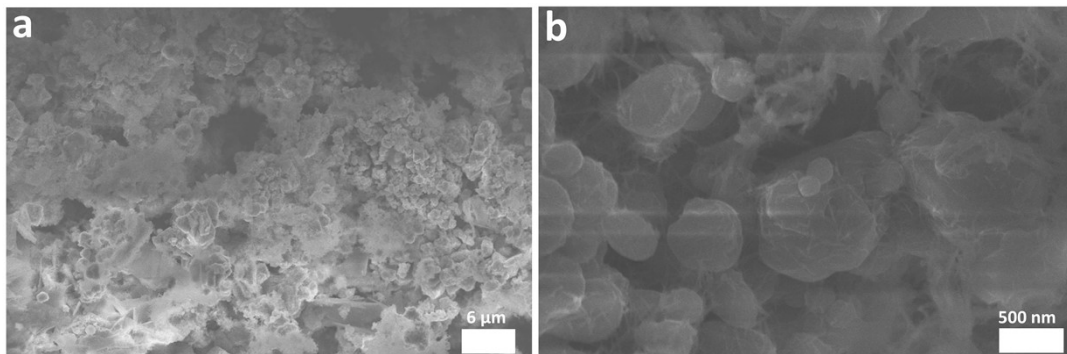
**Fig S3** SEM images of the prepared (a, b) CoS powders and (c, d) CoS<sub>2</sub> powders.



**Fig S4** SEM images of the prepared (a, b) FeS<sub>2</sub> and (c, d) NiS<sub>2</sub>.



**Fig S5** SEM images of the prepared (a, b)  $\text{Cu}_7\text{S}_4$  and (c, d)  $\text{CdS}$ .



**Fig S6** SEM images of the prepared  $\text{MnS}$ .

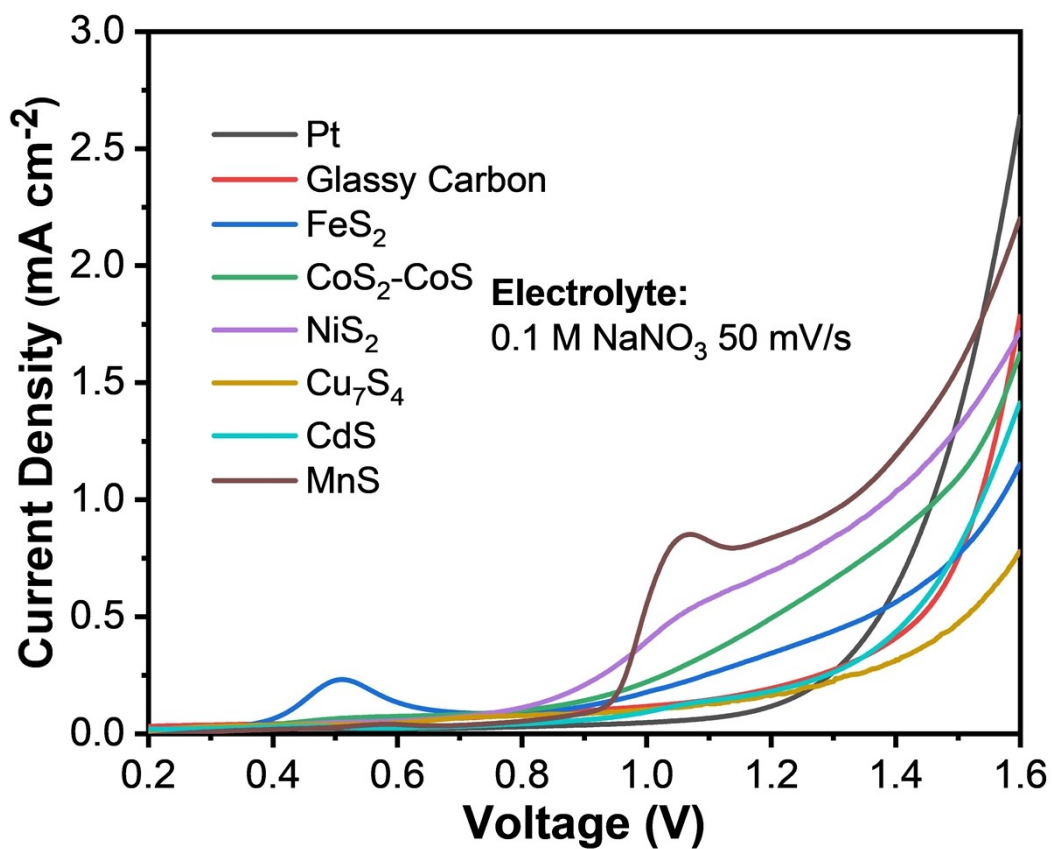


Fig S7 LSV curves of the different working electrodes in 0.1 M NaNO<sub>3</sub>. Scan rate: 50 mV/s.

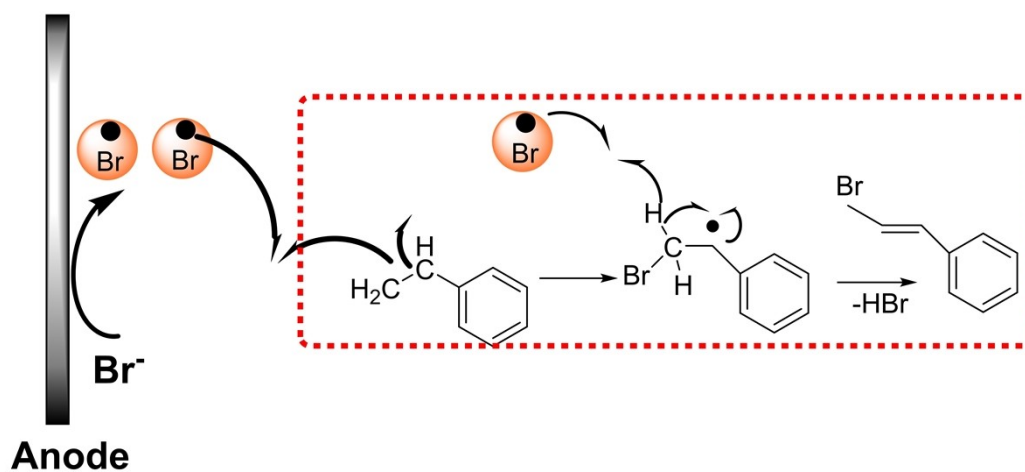
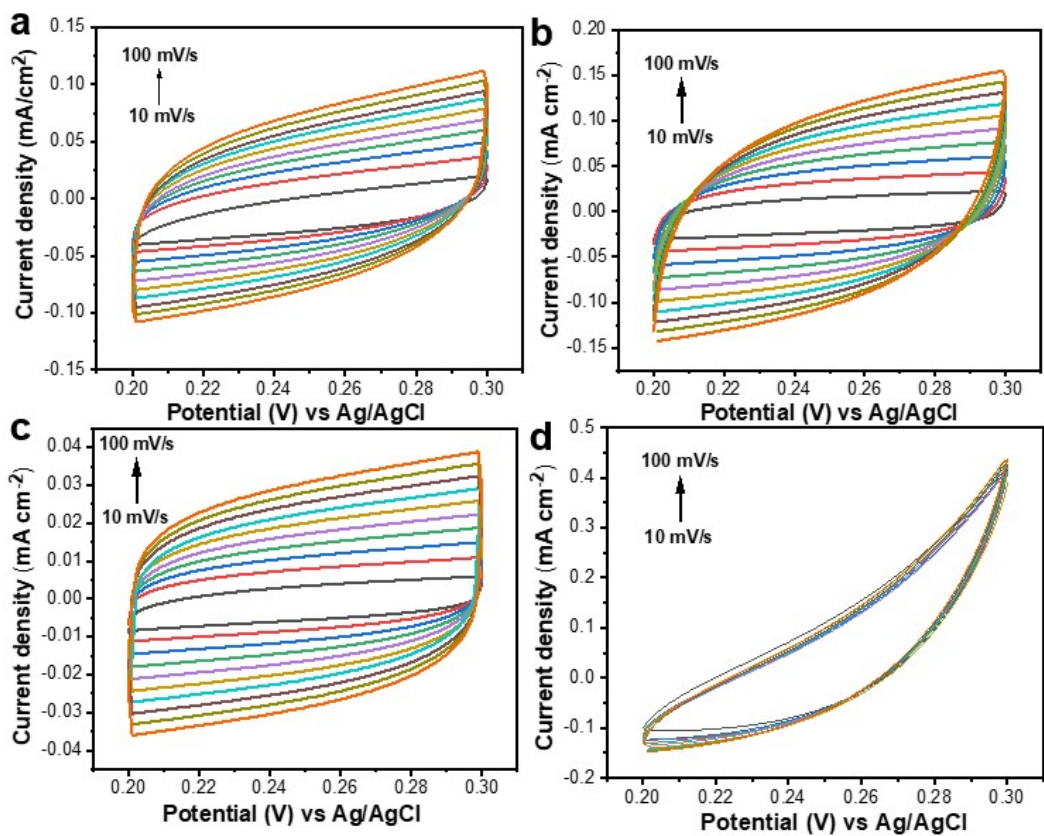
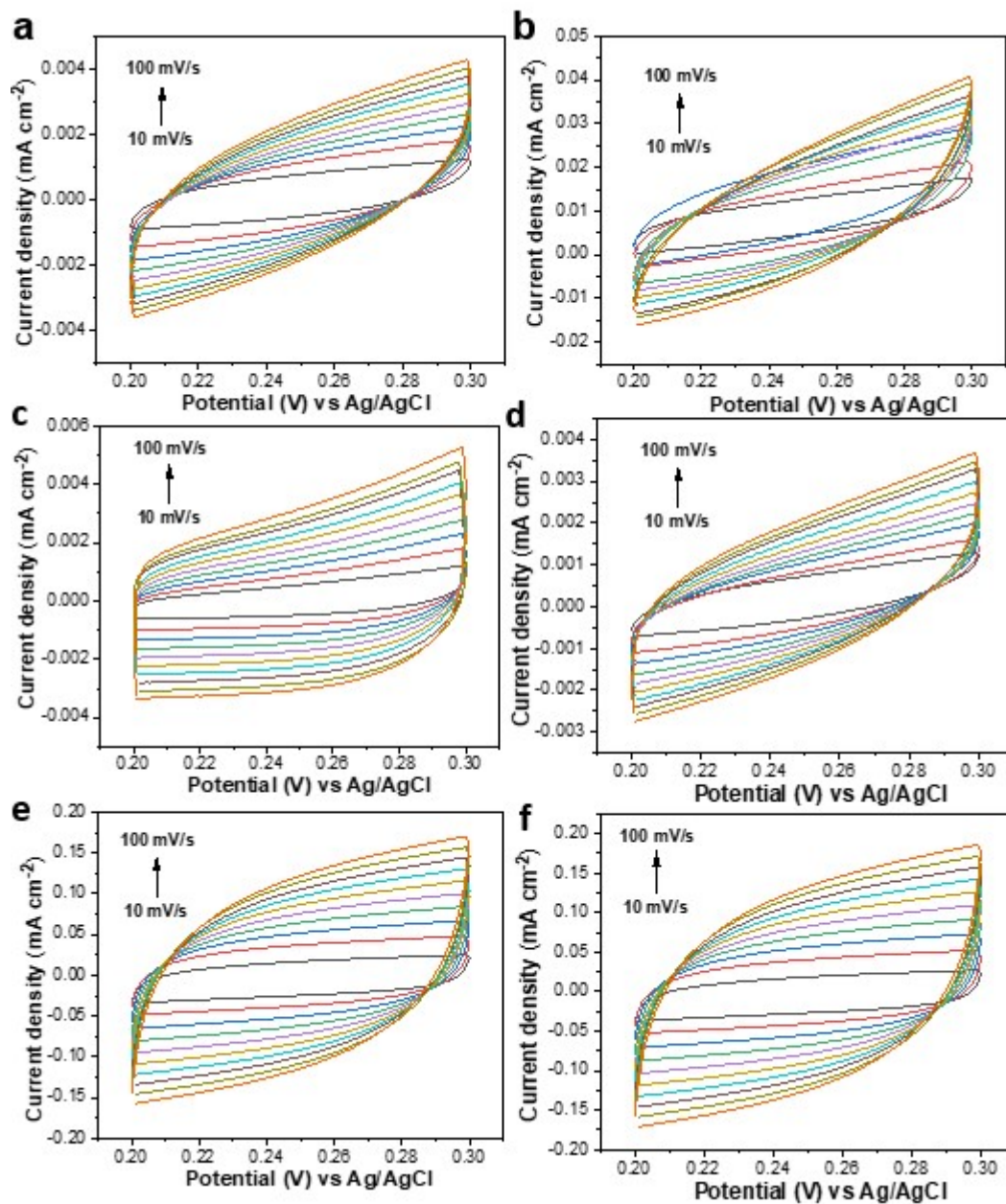


Fig S8 The mechanism of the  $\beta$ -bromostyrene formation.

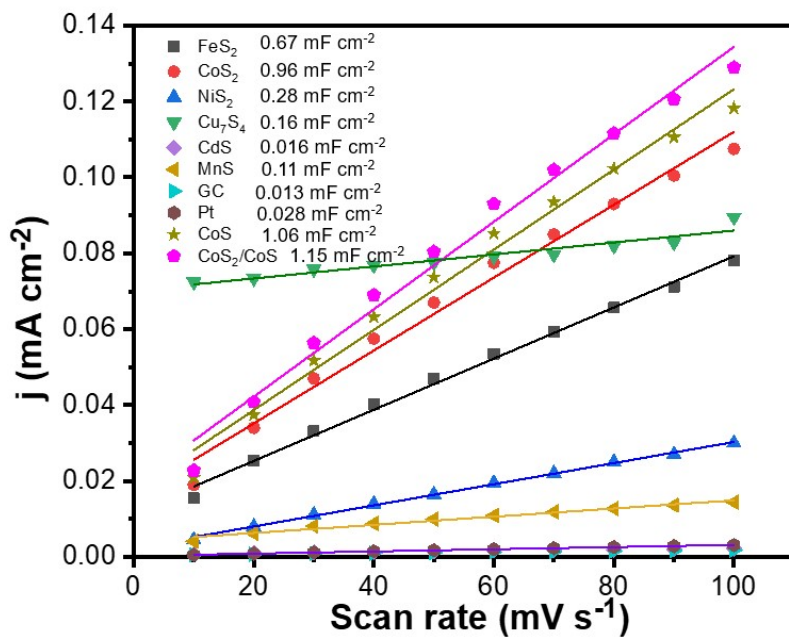


**Fig S9** The cyclic voltammety spectra for (a) FeS<sub>2</sub>, (b) CoS<sub>2</sub>, (c) NiS<sub>2</sub>, (d) Cu<sub>7</sub>S<sub>4</sub> in 0.5 M NaBr aqueous solution in the potential range of 0.2 - 0.3 V. Counter electrode: Platinum. Reference electrode: Ag/AgCl. Scan rate: 10 – 100 mV/s.

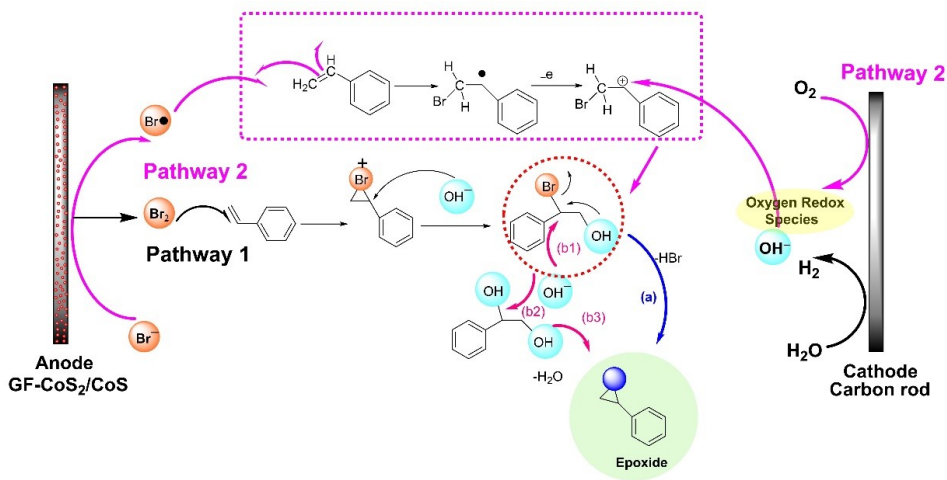




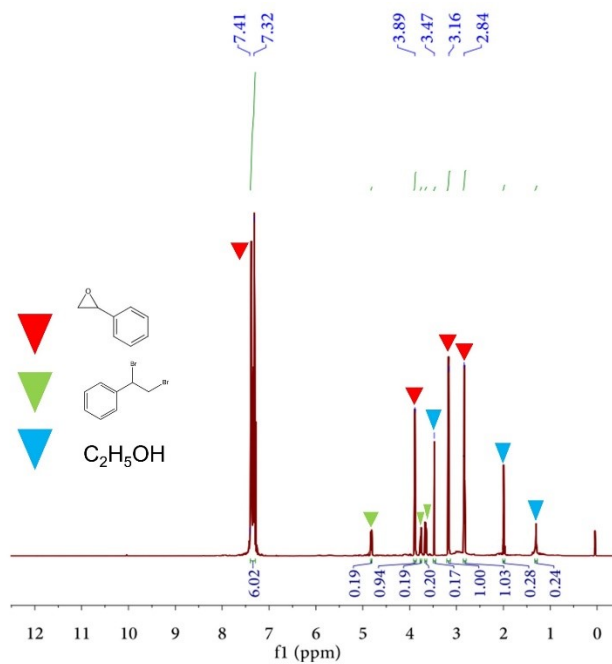
**Fig S10** The cyclic voltammety spectra for (a) CdS, (b) MnS, (c) Pt, (d) Glassy Carbon, (e) CoS, (f) CoS<sub>2</sub>/CoS in 0.5 M NaBr aqueous solution in the potential range of 0.2 - 0.3 V. Counter electrode: Platinum. Reference electrode: Ag/AgCl. Scan rate: 10 – 100 mV/s.



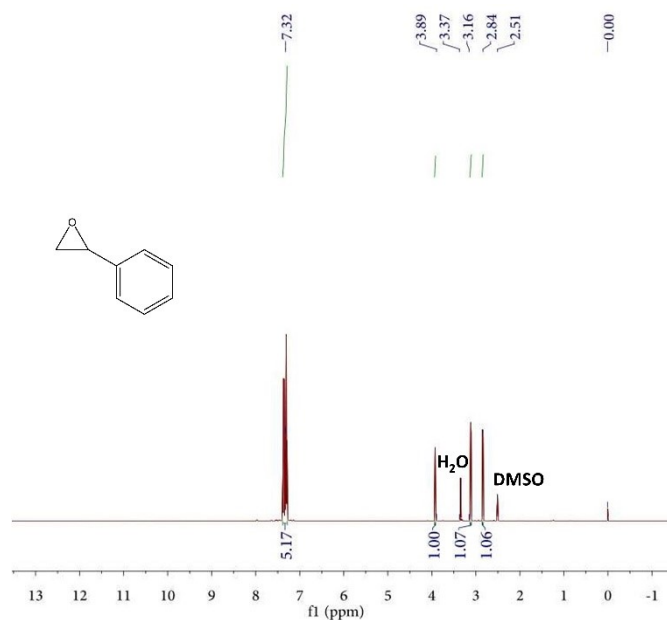
**Fig S11** Capacitive currents at 0.25 V (vs. Ag/AgCl) of FeS<sub>2</sub>, CoS<sub>2</sub>, NiS<sub>2</sub>, Cu<sub>7</sub>S<sub>4</sub>, CdS, MnS, GC, Pt, CoS, CoS<sub>2</sub>/CoS in 0.5 M NaBr buffer solution.



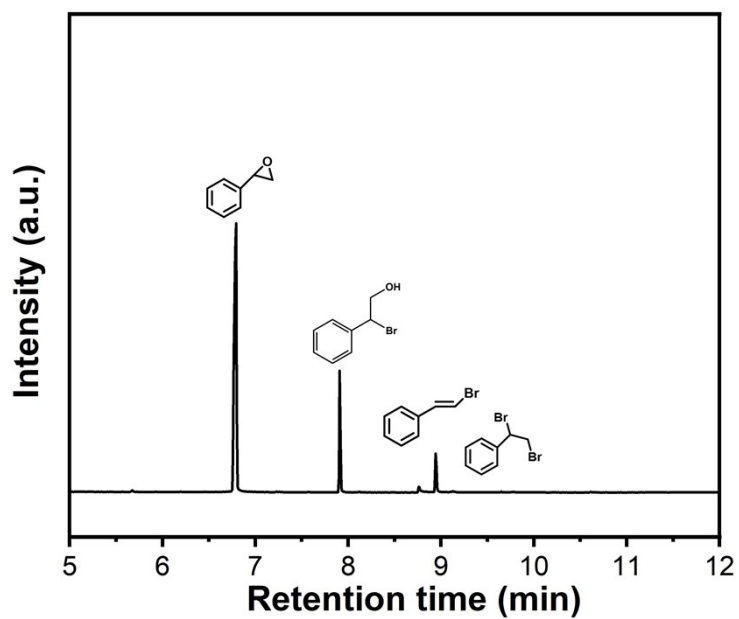
**Fig S12** Reaction mechanism involved in electro-epoxidation.



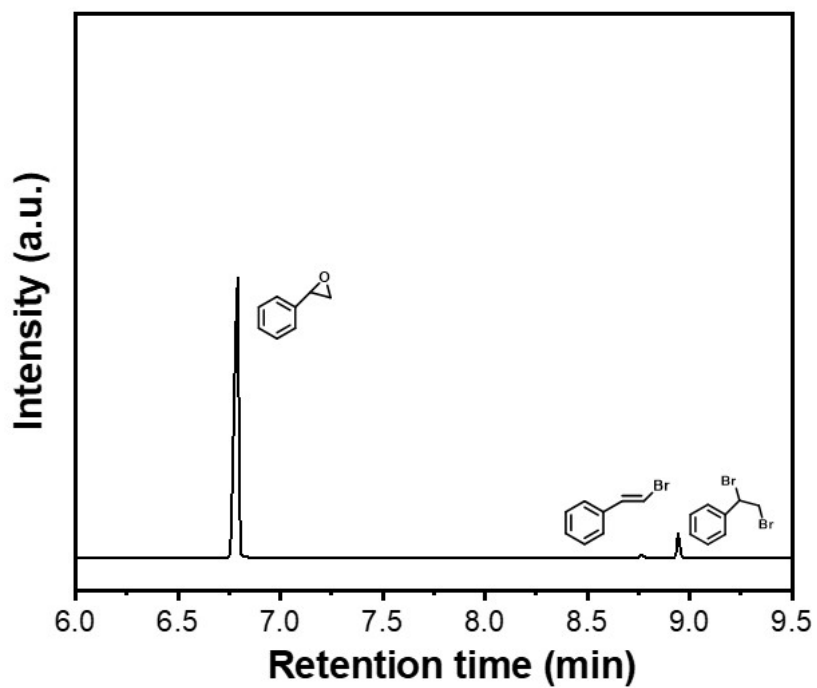
**Fig S13**  $^1\text{H-NMR}$  for the mixture products from the electro-epoxidation of styrene after 3 hours of the reaction.



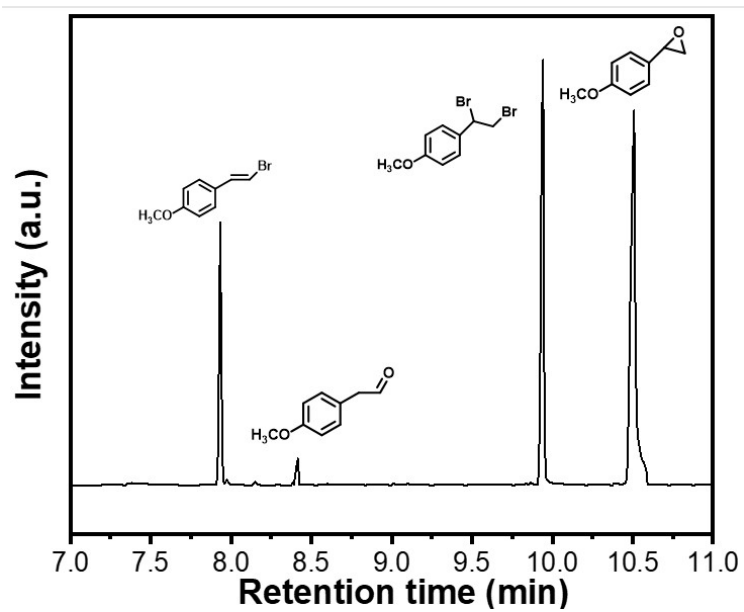
**Fig S14**  $^1\text{H-NMR}$  for the styrene oxide after column separation.



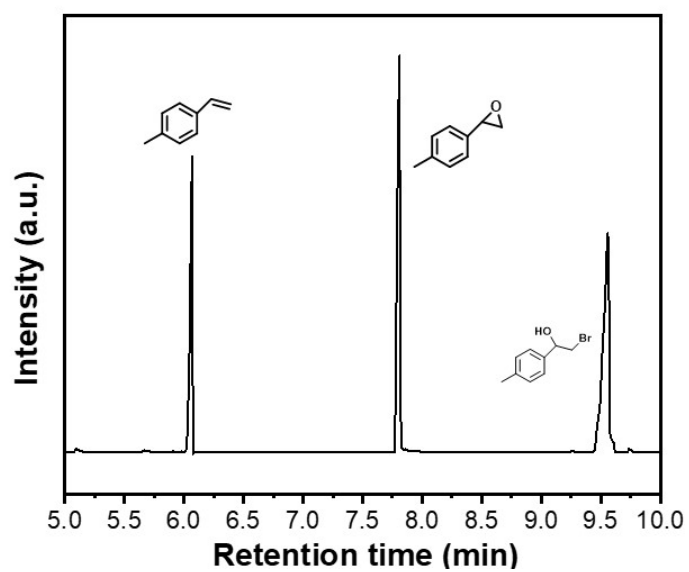
**Fig S15** GC-MS data for bromohydrin during the electrochemical epoxidation for 1 h.



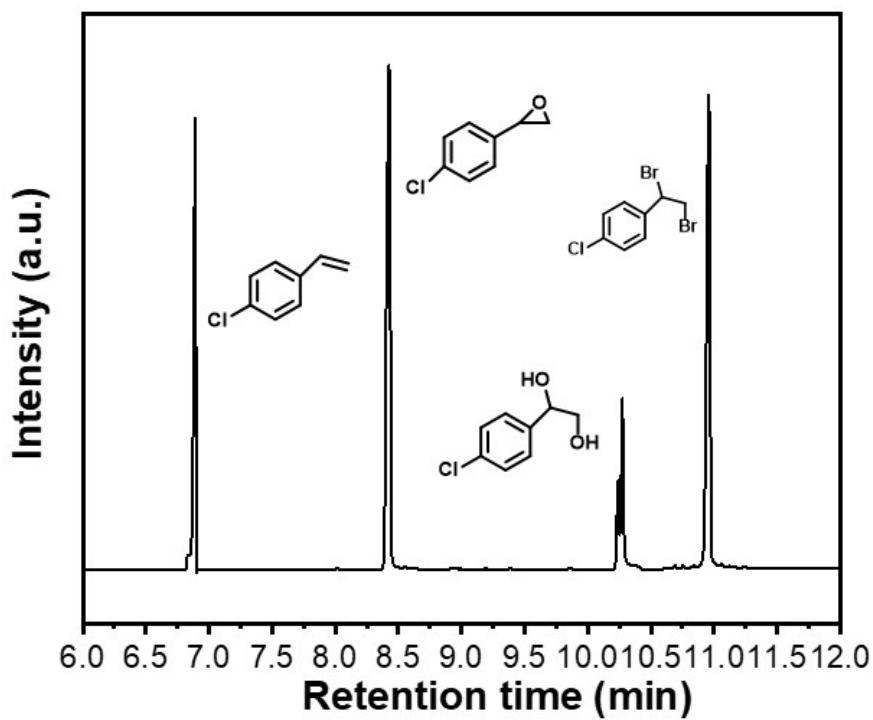
**Fig S16** GC-MS data for styrene after electrochemical epoxidation for 4 h.



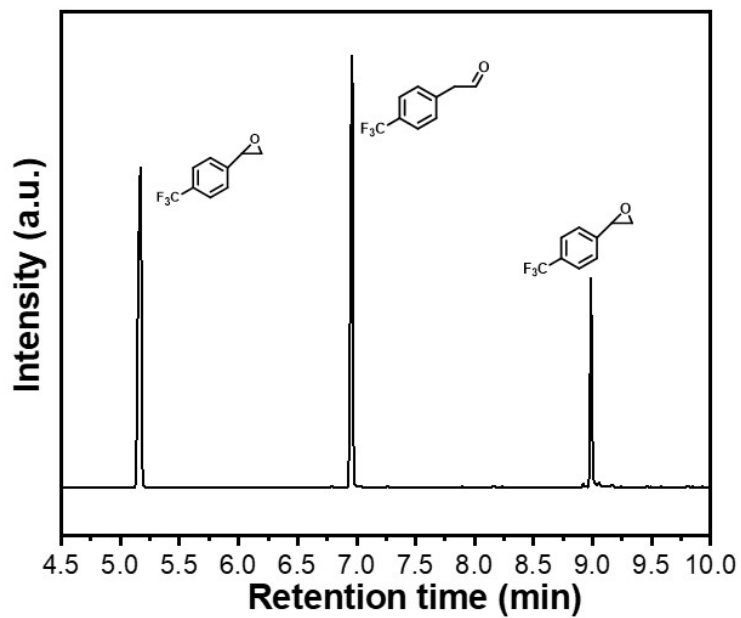
**Fig S17** GC-MS data for 4-Methoxystyrene after electrochemical epoxidation for 4 h.



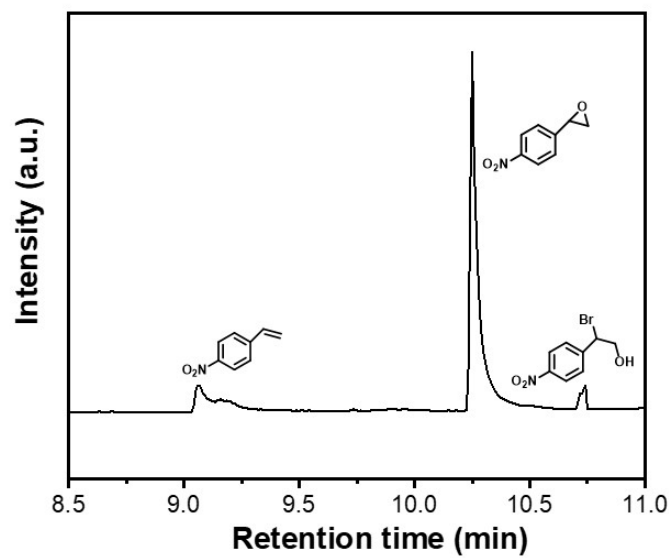
**Fig S18** GC-MS data for 4-methylphenylene after electrochemical epoxidation for 4 h.



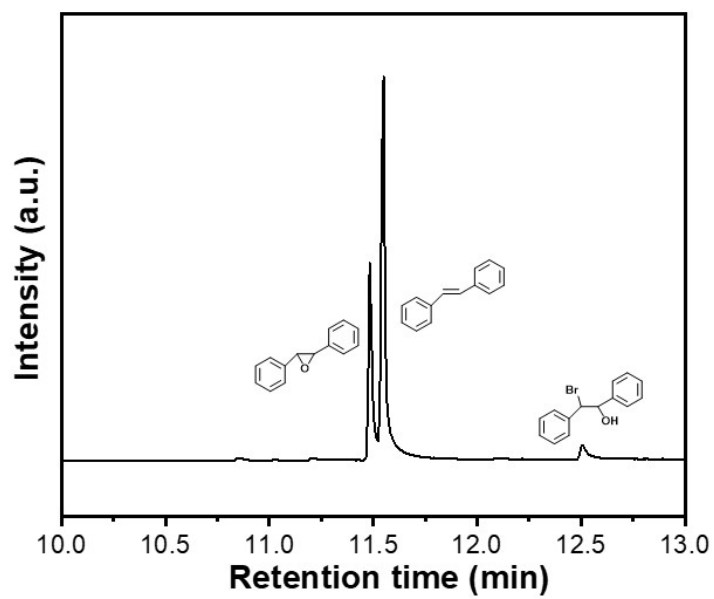
**Fig S19** GC-MS data for 4-chlorostyrene after electrochemical epoxidation for 4 h.



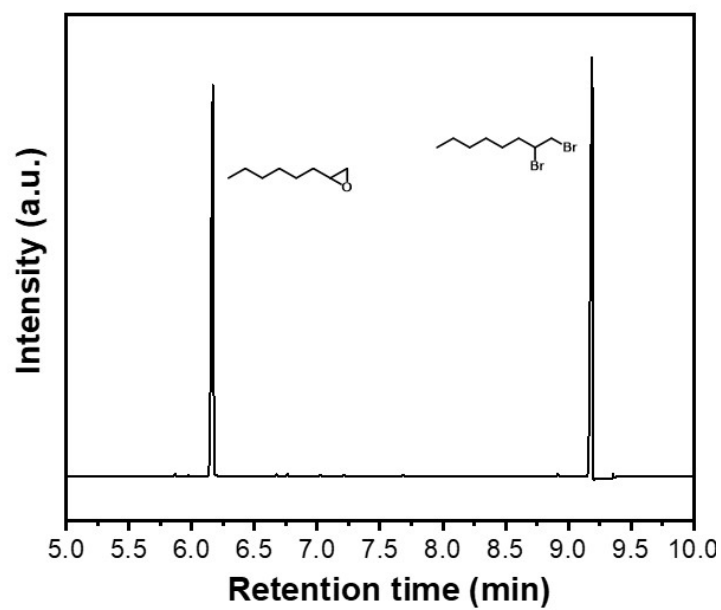
**Fig S20** GC-MS data for 4-(trifluoromethyl)-styrene after electrochemical epoxidation for 4 h.



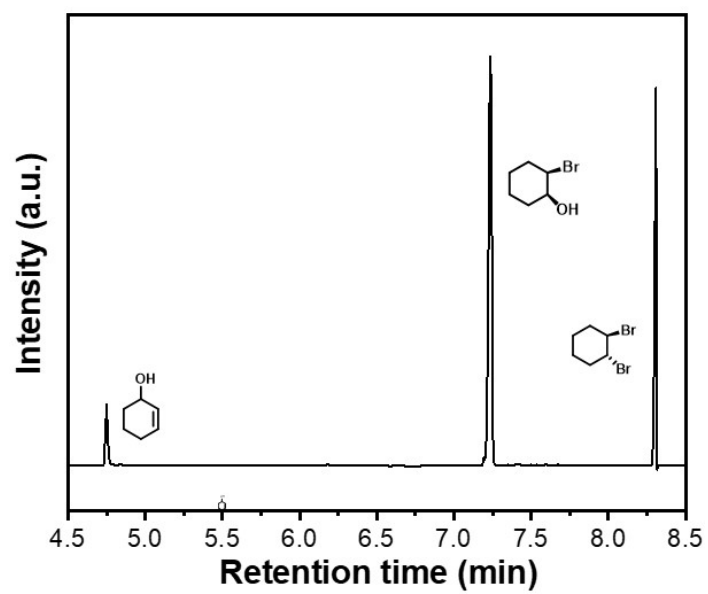
**Fig S21** GC-MS data for 4-nitrostyrene after electrochemical epoxidation for 4 h.



**Fig S22** GC-MS data for stilbene after electrochemical epoxidation for 4 h.



**Fig S23** GC-MS data for octene after electrochemical epoxidation for 4 h.



**Fig S24** GC-MS data for cyclohexene after electrochemical epoxidation for 4 h.