Supporting information

Elucidating the Mechanism of Li Insertion into $Fe_{1-x}S$/Carbon via *in Operando* Synchrotron Studies

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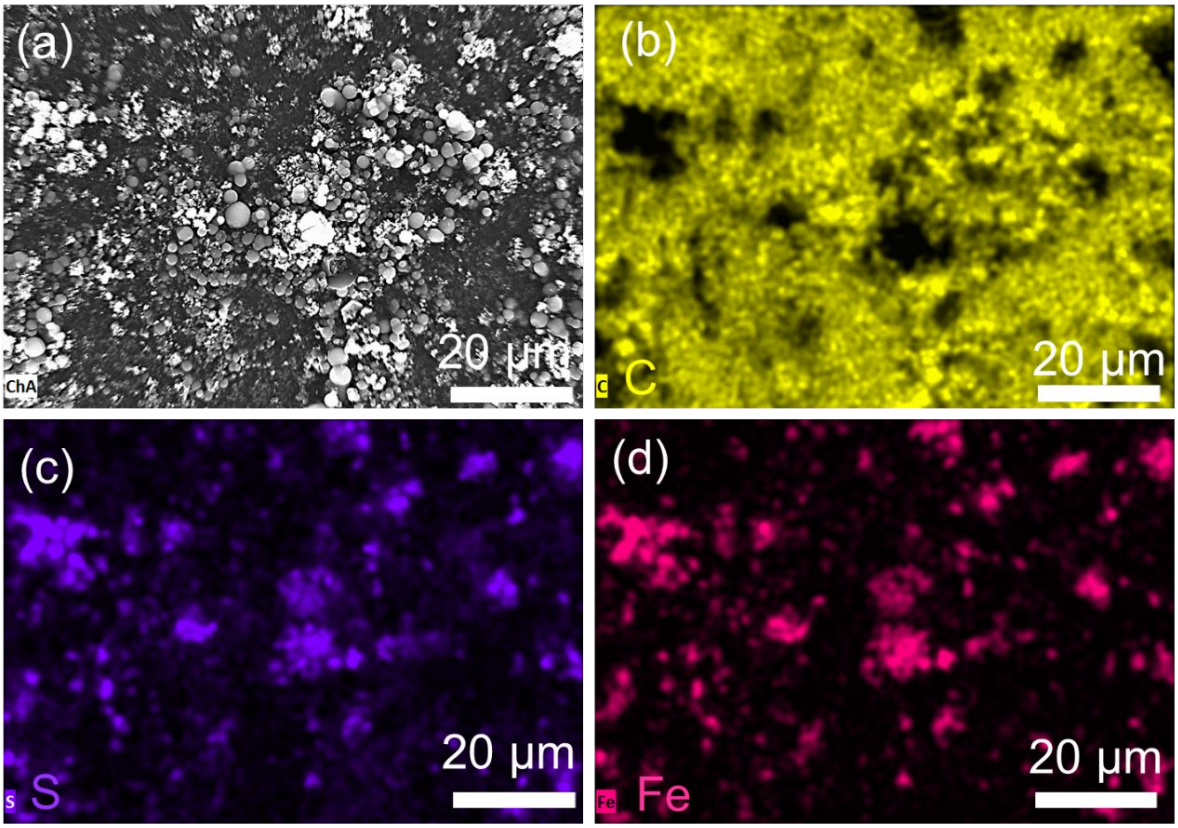

Figure S1. The SEM-EDS elemental mappings of the $Fe_{1-x}S/C$ material (a-d).

Table S1. The phase fraction, space group, and cell parameters of the $Fe_{1-x}S/C$ and $Fe_{1-x}S/C$-LP30-1h.

		$Fe_{1-x}S/C$			$Fe_{1-x}S/C$-LP30-1h		
Phase name	Space group	*a* (Å)	*b* (Å)	*c* (Å)	*a* (Å)	*b* (Å)	*c* (Å)
FeS	*P-62c*	5.951	5.951	11.451	5.958	5.958	11.434
Fe_7S_8	*C2/c*	11.915	6.888	12.917	--	--	--
$Fe_{7-x}S_8$	*C2/c*	11.735	6.679	12.372	--	--	--
Fe_9S_{10}	$P2_1$	--	--	--	6.863	28.930	6.887
Fe_3C	*Pnma*	4.988	6.743	4.304	4.945	6.773	4.306

Table S2. The Rietveld refinements (Chi2, R_p, and R_{wp}, No. of variables reflections etc.) of the $Fe_{1-x}S/C$ and $Fe_{1-x}S/C$-LP30-1h.

	$Fe_{1-x}S/C$	$Fe_{1-x}S/C$-LP30-1h
Chi2	6.12	1.94
R_p	1.77	3.62
R_{wp}	2.52	5.03
No. of variables reflections	1303 (FeS);	7606 (Fe_9S_{10});
	8570 (Fe_7S_8)	398 (FeS)
	10772 ($Fe_{7-x}S_8$);	289 (Fe_3C)
	1287 (Fe_3C)	

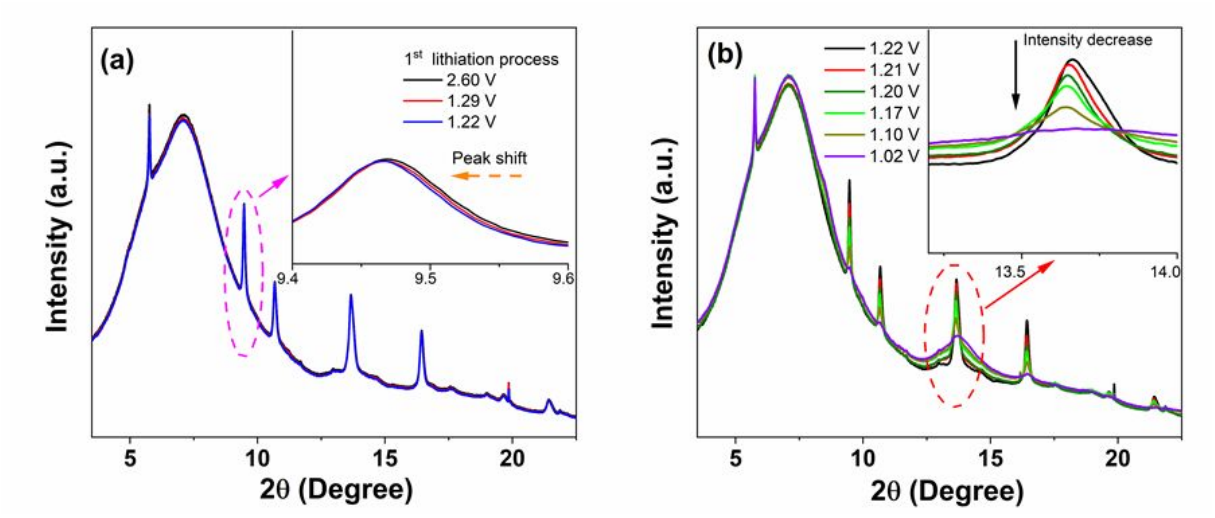

Figure S2. (a) The magnification of the reflection shift (9.4-9.6 °) during the 1st lithiation process (2.60→1.22 V). (b) The reflection intensity (13.2-14.0 °) decreases during the 1st lithiation process (1.22→1.02 V).

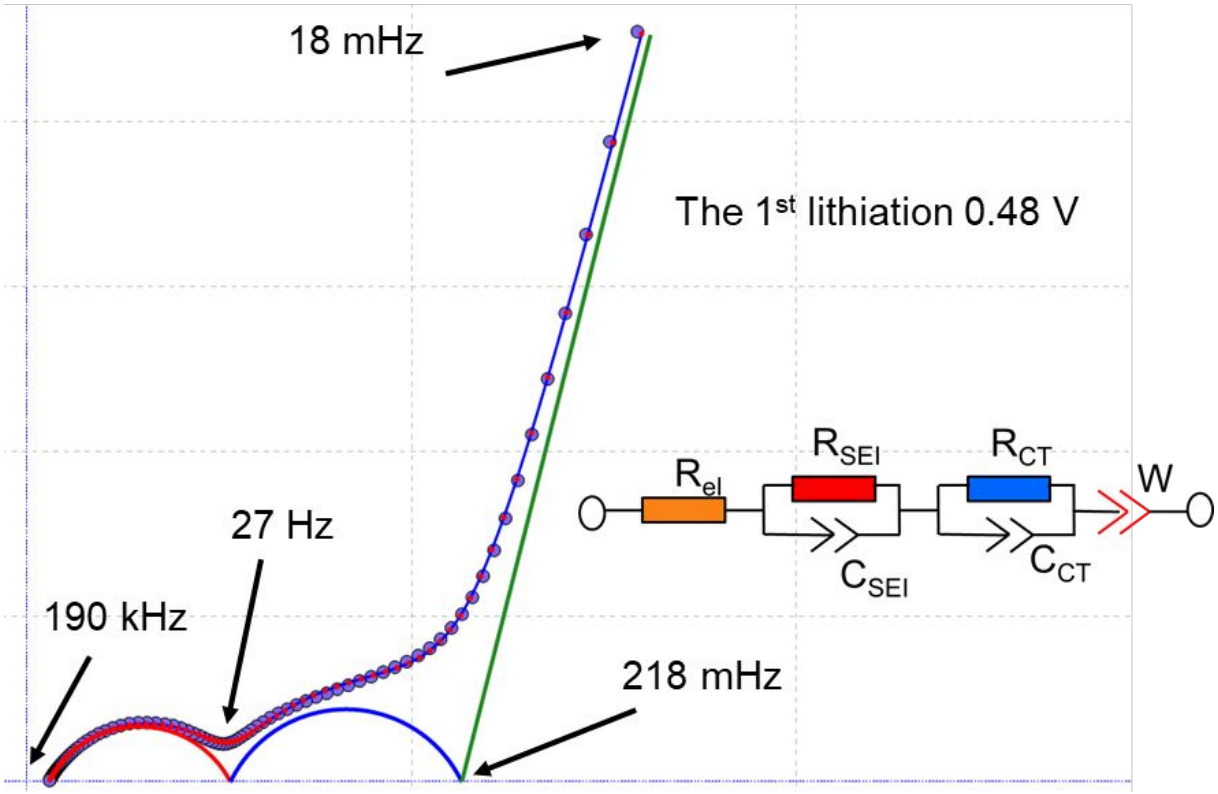

Figure S3. Nyquist plot obtained at the 1st lithiation 0.48 V of the $Fe_{1-x}S/C$ electrode.