

1 **Dual functional additives enabling high-performance silicon–**
2 **carbon composite anode in punch cell at high temperature**

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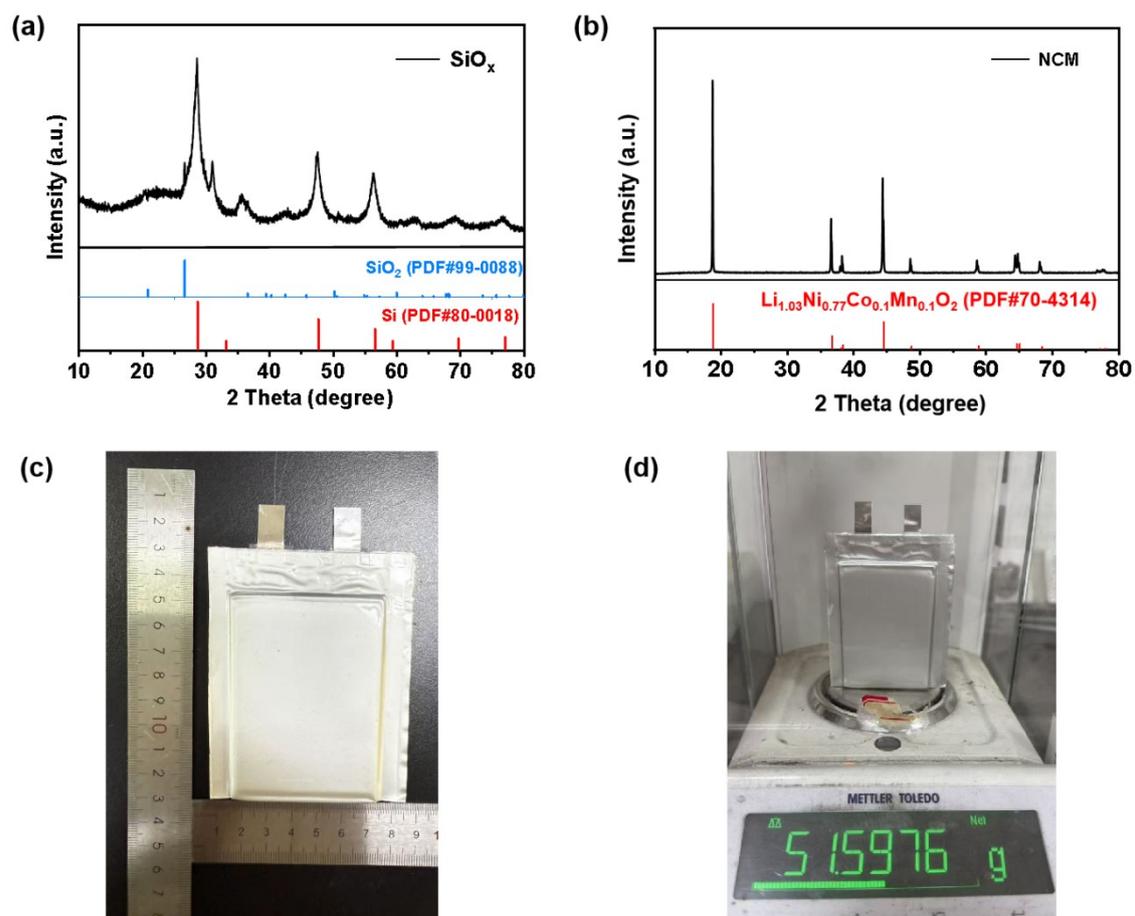
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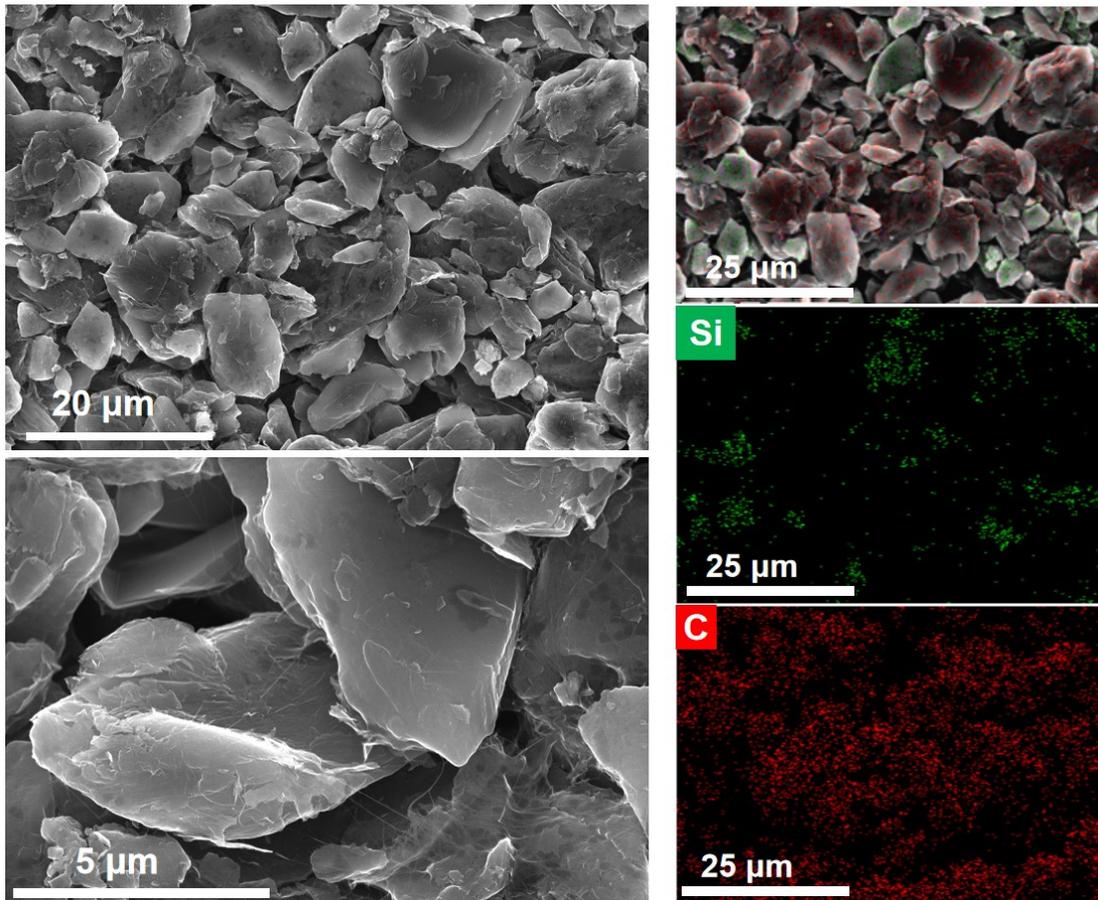
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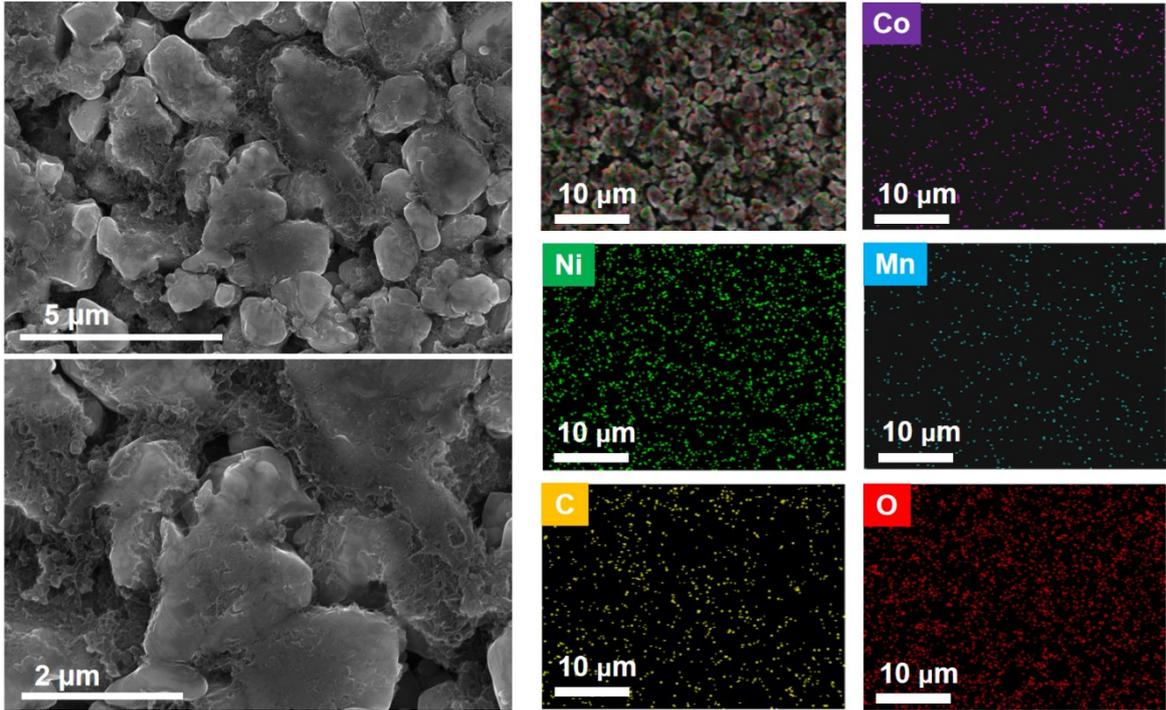
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21 **Fig. S1.** The XRD patterns of (a) SiO_x and (b) NCM. The digital pictures of (c) the size
22 and (d) weight of the NCM811/Si-C pouch cells.

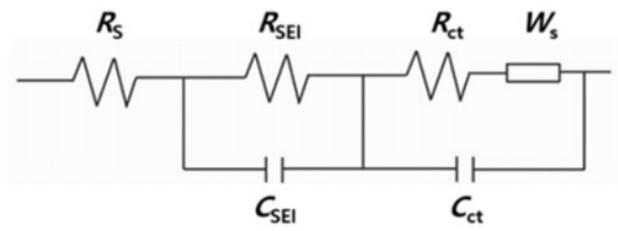
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25 **Fig. S2.** The SEM and SEM-EDS mappings of Si-C anode before cycling.
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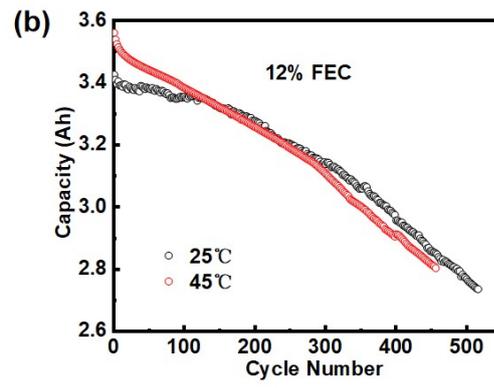
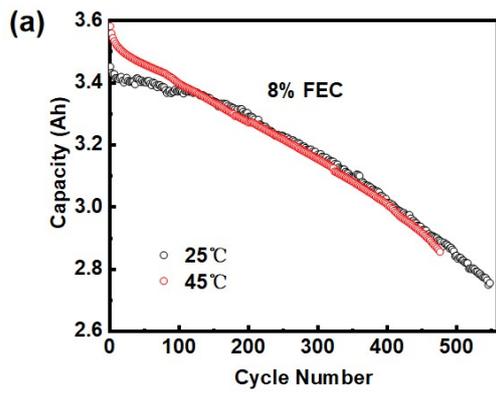


27 **Fig. S3.** The SEM and SEM-EDS mappings of NCM811 cathode before cycling.
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29 **Fig. S4.** The equivalent circuit for Nyquist plots.

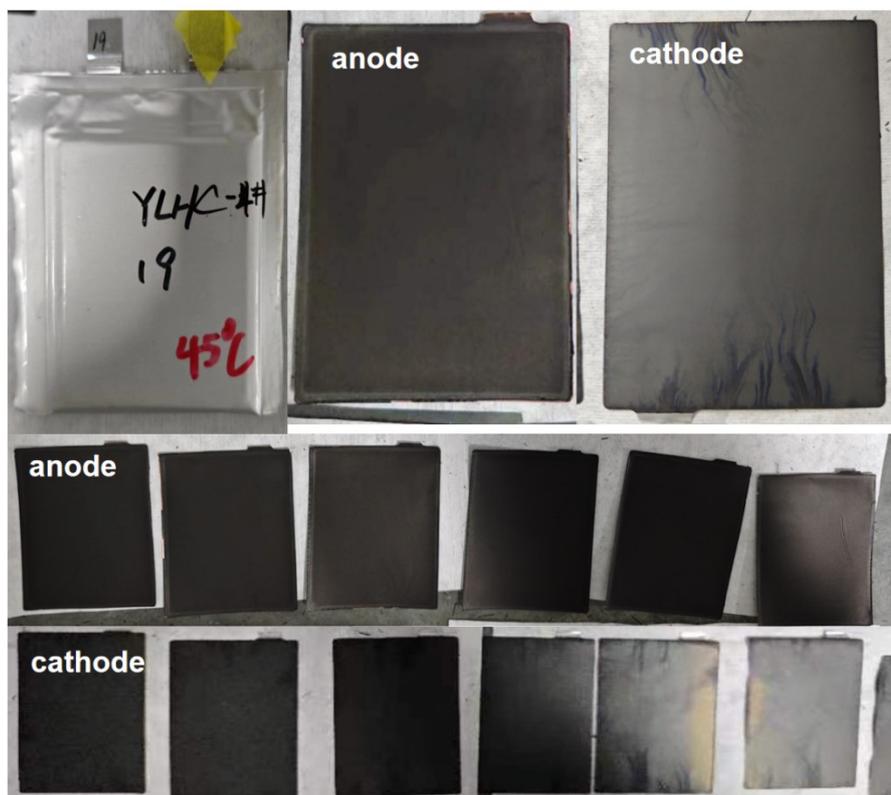
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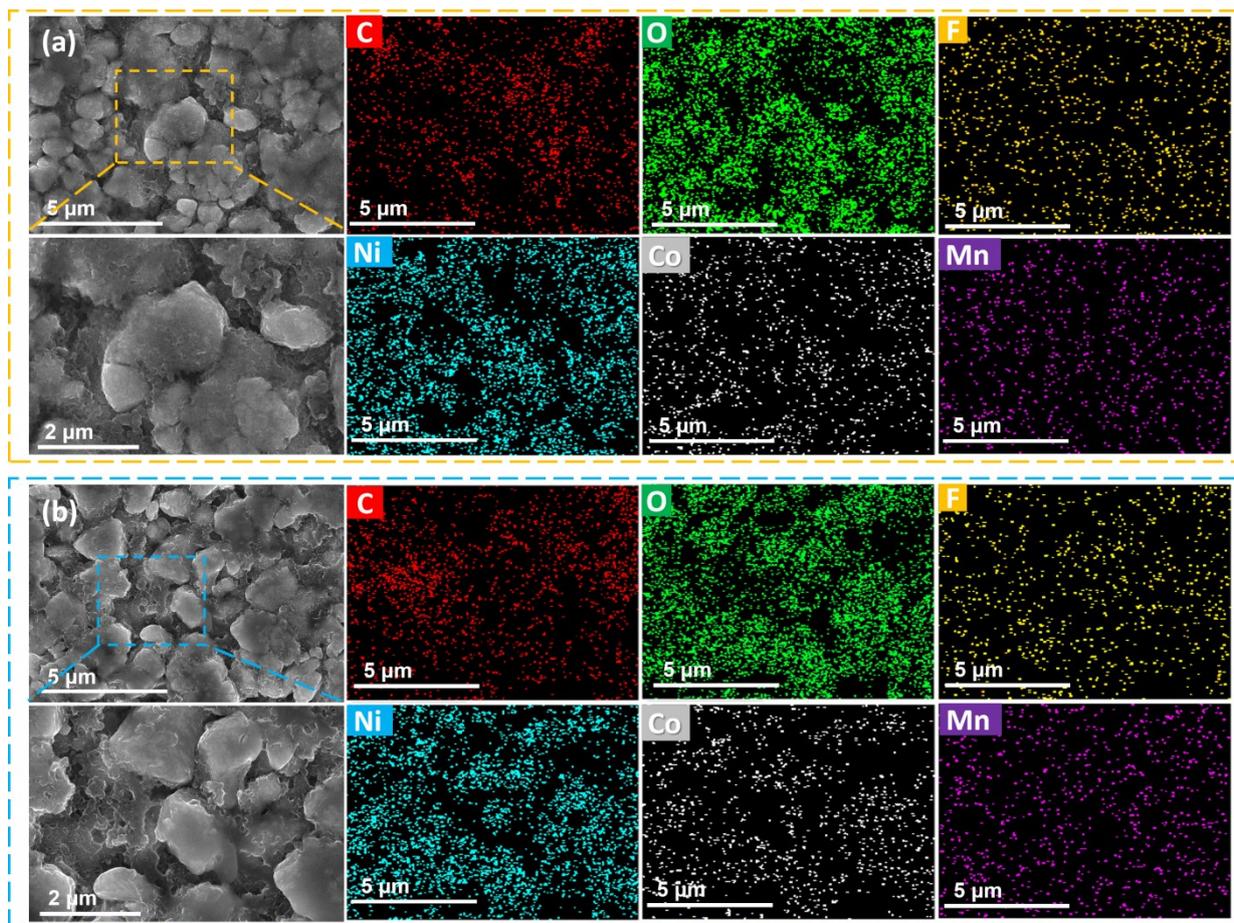
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32 **Fig. S5.** The cycling performance of the pouch cells with (a) 8% FEC and (b) 12%
33 FEC at 25 °C and 45 °C.

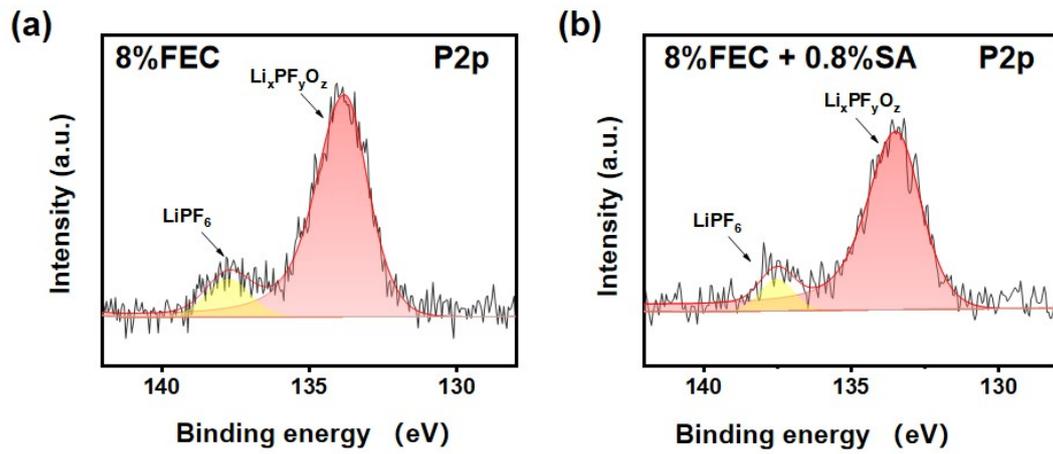
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35 **Fig. S6.** The optical photographs of the disassembled pouch cells using FEC-SA dual
36 additives after 450 cycles at 45 °C.
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38 **Fig. S7.** SEM images and corresponding EDS maps of NCM811 cathode using (a) 8% FEC and
 39 (b) 8% FEC + 0.8% SA electrolytes after 450 cycles at high temperature.
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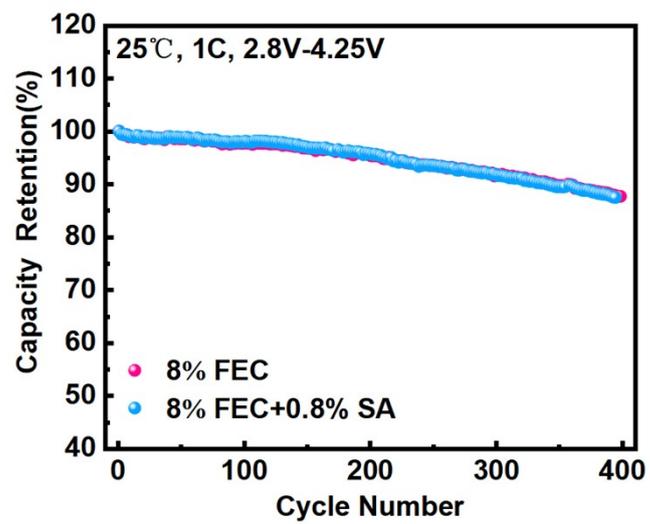


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42 **Fig. S8.** The P 2p XPS spectra of the Si-C composite anodes with (a) 8% FEC and (b) 8% +0.8%

43 SA electrolytes after 450 cycles.

44



45 **Fig. S9.** Cycling performance of pouch cells with single FEC additive and SA-FEC dual
46 additives at room temperature.
47

48 **Table S1.**

49 **The detail parameters of 1 Ah-level NCM811/SiO_x-C pouch cells.**

Cell capacity (Ah)	3.5	
Cell weight (g)	51.6	
Gravimetric energy density (Wh kg ⁻¹)	203.5	
Volumetric energy density (Wh L ⁻¹)	280.5	
Cathode	Active material	LiNi _{0.8} Mn _{0.1} Co _{0.1} O ₂
	Active material percentage (wt%)	97
	Area weight (each side, mg cm ⁻²)	19.44
	Length (mm)	76
	Width (mm)	53.5
	Thickness (μm)	165
Anode	Active materials	SiO _x -C
	Active material percentage (%)	90
	Area weight (each side, mg cm ⁻²)	9.47
	Length (mm)	56.5
	Width (mm)	79
	Thickness (μm)	210
Layer of cathodes	14	
Layer of anodes	15	
Negative to positive capacity ratio		1.05
Thickness of separator (μm)		16
Thickness of packing foil (μm)		200
Electrolyte to capacity ratio (g Ah ⁻¹)		4.5

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52 **Table S2.**

53 **Representative electrolyte functional additives for full cell consisted of high-nickel (Ni**

54 **$\geq 80\%$) cathodes and Si-based anodes**

Cell component	Additive	Electrolyte	Cycling condition	capacity retention	Reference
SiO _x -C/NCM811 (9.47 mg cm ⁻² , 19.44 mg cm ⁻²) Pouch cell	8% FEC + 0.8% SA	1 M LiPF ₆ in EC/EMC/DEC (1:1:1 volume ratio)	1 C, 45 °C	80% after 550 cycles	This work
S650/NMC811 (3.5 mAh cm ⁻² , 17.2 mg cm ⁻²) Coin cell	0.5 wt.% LiTFTCP	1 M LiPF ₆ in EC/EMC (3:7 volume ratio)	2 C, 50 °C	80.9% after 450 cycles	[1]
SiO-graphite/NCM-88 (3.5 mAh cm ⁻²) Coin cell	0.4 wt.% IF-CE (icosafuoro-15 crown-5-ether) + 2 wt.% FEC	1 M LiPF ₆ in EC/EMC/DEC (25:45:30 volume ratio)	1 C, 45 °C	88% after 100 cycles	[2]
SiG-C/LiNi _{0.8} Co _{0.1} Mn _{0.1} O ₂ (4.21 mAh cm ⁻²) Coin cell	1 wt.% VC + 0.5 wt.% APFS (4 (allyloxy)phenyl fluorosulfate)	1 M LiPF ₆ in EC/EMC/DEC (25:45:30 vol.%)	1 C, 45 °C	72.5% after 300 cycles	[3]
SiO _x @Gr NMC811 Pouch cell	30 wt.% FEC	1.0 M LiPF ₆ in EC/DEC (3:7 weight ratio)	0.3 C, 45 °C	83.3% after 100 cycles	[4]
SiO _x /Gr LiNi _{0.90} Mn _{0.05} Co _{0.05} O ₂ (1.8 mAh·cm ⁻²) Coin cell	4.0 wt.% FEC	3.2 M LiFSI in DMC	0.3 C, 45 °C	82.1% after 100 cycles	[5]

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