Supporting Information

Advanced *In-Situ* Technology for Li/Na Metal Anodes: An In-Depth Mechanism Understanding

Jun Pu,‡ *[,a] Chenglin Zhong,‡ [b,c] Jiahao Liu, [c] Zhenghua Wang, [a] and Dongliang Chao *[,c]

[a] Key Laboratory of Functional Molecular Solids, Ministry of Education, Anhui Provincial Engineering Laboratory for New-Energy Vehicle Battery Energy-Storage Materials, College of Chemistry and Materials Science, Anhui Normal University, Wuhu 241002, China. *E-mail:* jpu@ahnu.edu.cn. *(J. Pu)*

[b] College of Chemistry and Chemical Engineering, Linyi University, Linyi 276005, Shandong, China

[c] Laboratory of Advanced Materials, Fudan University, Shanghai 200433, China. *Email:* chaod@fudan.edu.cn. *(D. Chao)*

‡ These authors contributed equally to this work

Summary of Li/Na metal anodes with different *in-situ* technologies:

Table S1. Performance and parameters of Li/Na anodes with functional solvents or Li/Na salts.

Solvents or Li/Na salts	Half cells test				Symmetrical cells test			Ref.
	Current (mA cm^{-2})	Capacity (mAh cm^{-2})	CE	Cycle	Current (mA cm^{-2})	Capacity (mA cm^{-2})	Cycle	
FEC solvent	--	--	--	--	2	3.3	~1100	1
VEC solvent	0.5	0.5	98.1%	1400	1	1	500	2
FFS solvent	0.5	0.5	99%	400	0.5	0.5	550	3
LiTFPFB salt	--	--	--	--	0.5	0.5	250	4
LiHFDF salt	--	--	--	--	0.5 2	1 4	250 ~90	5
NaDFOB salt	--	--	--	--	1.5	0.1	515	6

Annotations:

1. FEC: fluoroethylene carbonate

   VEC: vinylethylene carbonate

   FFS: "full fluorosulfonyl" electrolyte

   LiTFPFB: lithium trifluoro(perfluoro-tert-butyloxyl)borate

   LiHFDF: lithium 1, 1, 2, 2, 3, 3-hexafluoropropane-1, 3-disulfonimide

   NaDFOB: sodium-difluoro(oxalato)borate

2. "--" means that no information is provided in the literature.

Table S2. Performance and parameters of Li/Na anodes with different additives.

Additives	Half cells test				Symmetrical cells test			Ref.
	Current (mA cm^{-2})	Capacity (mAh cm^{-2})	CE	Cycle	Current (mA cm^{-2})	Capacity (mA cm^{-2})	Cycle	
Li_2S_8	0.5	0.5	~97%	~120	10	10	2000	7
PSD	2 2 2	1 2 3	99.1% 99% 98.9%	420 250 250	--	--	--	8
PST	2 2 2	1 2 3	99% 98.9% 98.6%	400 220 220	--	--	--	9
$LiPO_2F_2$	--	--	--	--	0.5 1	0.5 1	250 100	10
LiDFOB	0.5	1	98.5%	200	1 2	1 1	300 180	11
KPF_6	--	--	--	--	0.5	0.5	216	12
SbF_3	--	--	--	--	0.5	0.5	~500	13
HFAA	--	--	--	--	1 2	0.5 1	200 100	14
TCBQ	--	--	--	--	5 3	2 1	~22 ~150	15
$AlCl_3$	0.5	2	99%	150	0.5	1	~237	16
$SiCl_4$	--	--	--	--	3	1	~500	17
SO_2Cl_2	0.5	0.5	95%	150	0.5 1	1 1	500 600	18

Annotations:

1. PSD: poly(sulfur-random-1,3-diisopropenylbenzene)

   PST: poly(sulfur-random-triallylamine)

   LiDFOB: lithium difluoro(oxalate)borate

   HFAA: hexafluoroacetylacetone

   TCBQ: tetrachloro-1,4-benzoquinone

2. "--" means that no information is provided in the literature.

Table S3. Performance and parameters of Li/Na anodes with high concentration electrolytes.

Additives	Half cells test				Symmetrical cells test			Ref.
	Current (mA cm^{-2})	Capacity (mAh cm^{-2})	CE	Cycle	Current (mA cm^{-2})	Capacity (mA cm^{-2})	Cycle	
4 M LiFSI-DME	4 10	1 1	98.4% 97%	1000 500	10	0.5	6000	19
2.1 M NaFSI/DME-BTFE	1	1	~99%	400	1 2	1 1	500 ~960	20
3 M $LiCF_3SO_3$-DOL/DME	1	3	98.6%	100	1	3	~135	21
4 M LiTFSI-LiDFOB-FEC/DMC	0.5	1	>98%	800	0.5	0.5	500	22
10 M LiFSI-EC/DMC	0.5	1	98.8%	150	--	--	--	23

Annotations:

1. "--" means that no information is provided in the literature.

Table S4. Performance and parameters of Li/Na anodes with *in-situ* protective layers.

Additives	Half cells test				Symmetrical cells test			Ref.
	Current (mA cm^{-2})	Capacity (mAh cm^{-2})	CE	Cycle	Current (mA cm^{-2})	Capacity (mA cm^{-2})	Cycle	
COF layer	--	--	--	--	1 2	1 2	200 200	24
PPy@Ni foam	1 1 1	2 5 10	99% 98% --	250 90 60	--	--	--	25
PDA@3D Cu	0.5 1 2	1 1 2	97.3% 96.2% 96.4%	200 150 150	1	1	500	26
CAM layer	3	1	99%	400	0.5	1.5	~258	27
LiECHFP layer	--	--	--	--	1 2 5	1 2 5	100	28
CPLi	--	--	--	--	3	2	~750	29
LiF layer	--	--	--	--	1 2 5	1 1 1	350 400 240	30
LPS layer	--	--	--	--	1 4	1 1	200 800	31
Li_3PS_4 layer	--	--	--	--	0.5	1	400	32
Na_3PS_4 layer	--	--	--	--	1 3	1 1	~135 ~210	33
$[LiNBH]_n$ layer	--	--	--	--	1 3	1 1	550 ~1050	34
Li-Al layer	--	--	--	--	0.5 5	1 1	800 ~1125	35
LiF/Cu layer	--	--	--	--	2.5	0.5	~2000	36

O-I hybrid layer	--	--	--	--	1 2	1 1	1500 1100	37
3D LiF-Li layer	--	--	--	--	1	1	800	38
LiF layer (G-S)	--	--	--	--	1 3 5	1 1 1	300 180 300	39
C-Li_2S-LiI layer	--	--	--	--	1 2 3	1 1 1	300 200 200	40
Al_2O_3 layer	--	--	--	--	0.25 0.25 0.5	0.125 1 1	900 50 30	41

Annotations:

1. COF: covalent organic framework

   PPy: polymerizing polypyrrole

   PDA: polydopamine

   CAM: cyanuric acid and melamine

   LiECHFP: lithium 2-((ethoxycarbonyl)oxy)-1,1,1,3,3,3-hexafluoro-propan-2-olate

   CPLi: carboxylate-protected Li

   LPS: Li_3PS_4

   O-I: organic-inorganic

   G-S: gas-solid reaction

2. "--" means that no information is provided in the literature.

Table S5. Performance and parameters of Li/Na anodes with *in-situ* polymer electrolytes.

Additives	Half cells test				Symmetrical cells test			Ref.
	Current (mA cm^{-2})	Capacity (mAh cm^{-2})	CE	Cycle	Current (mA cm^{-2})	Capacity (mA cm^{-2})	Cycle	
Quasi SSGPE	--	--	--	--	1	1	220	42
PEGA+PFE	--	--	--	--	2	4	1000	43

Annotations:

1. SSGPE: solid state gel polymer electrolyte
   PEGA+PFE: poly(ethylene glycol) methyl ether methacrylate + 2,2,3,3,3-pentafluoropropyl acrylate
2. “--” means that no information is provided in the literature.

Table S6. Performance and parameters of Li/Na anodes with *in-situ* growth techniques.

Additives	Half cells test				Symmetrical cells test			Ref.
	Current (mA cm^{-2})	Capacity (mAh cm^{-2})	CE	Cycle	Current (mA cm^{-2})	Capacity (mA cm^{-2})	Cycle	
Au NPs@C	0.5	1	>98%	300	--	--	--	44
Sn-C	2 2 2	1 3 5	99.7% 99.5% 99.3%	500 250 250	--	--	--	45
NaF@SnO_2-RGO	1	0.5	99.7%	3000	0.5	1	900	46

Annotations:

1. "--" means that no information is provided in the literature.

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