

# **Recovery of $\text{Li}_2\text{CO}_3$ from spent $\text{LiFePO}_4$ by using a novel impurity elimination process**

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## Supporting information

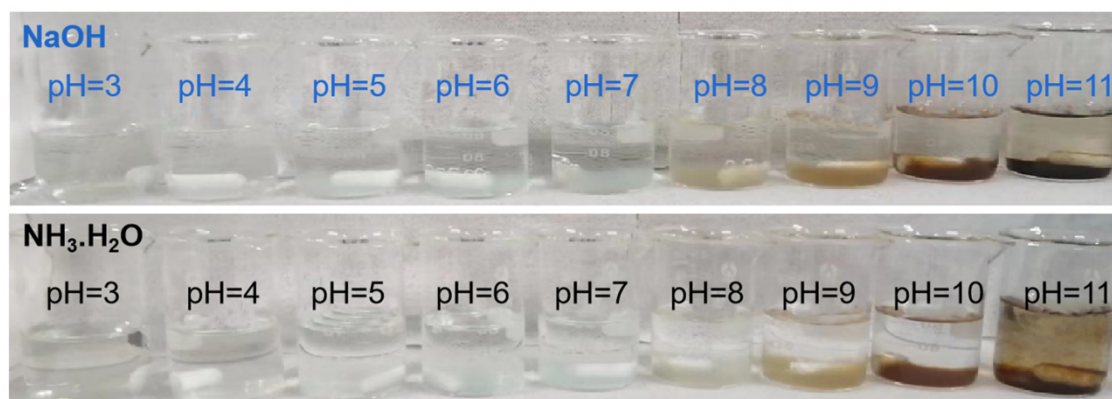


Figure S1. The photo of purified Li<sup>+</sup>-containing liquid obtained by adding purification reagent (NaOH and NH<sub>3</sub>·H<sub>2</sub>O).

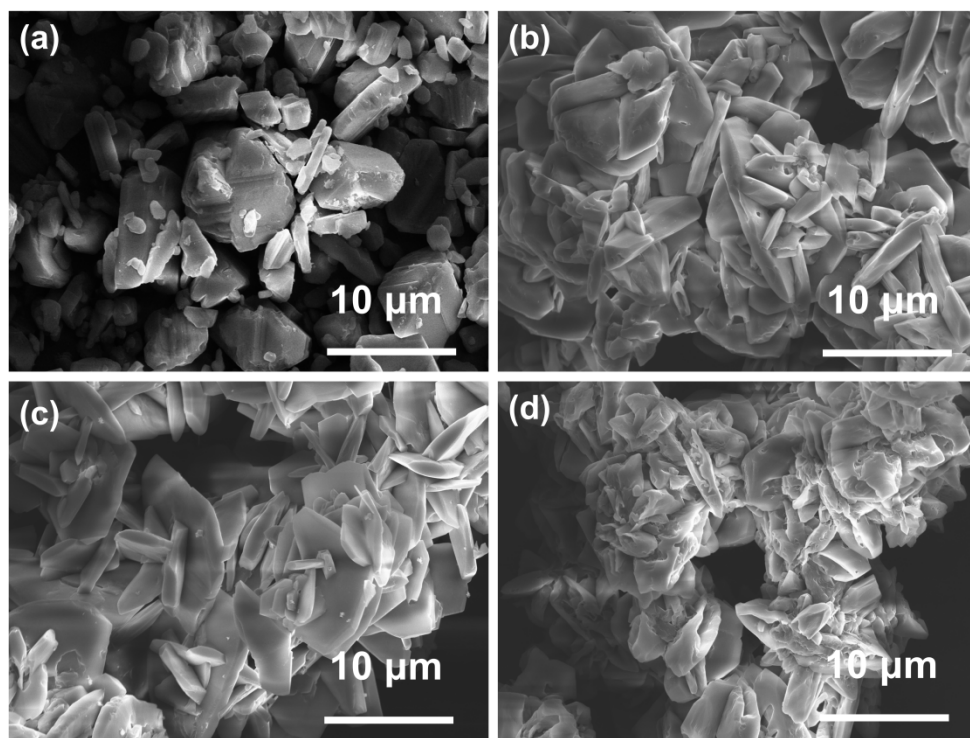


Figure S2. SEM of different lithium carbonate: (a) LCO<sub>commercial</sub>, (b) LCO<sub>Na</sub>, (c) LCO<sub>NH<sub>3</sub></sub> and (d) LCO<sub>NaNH<sub>3</sub></sub>.

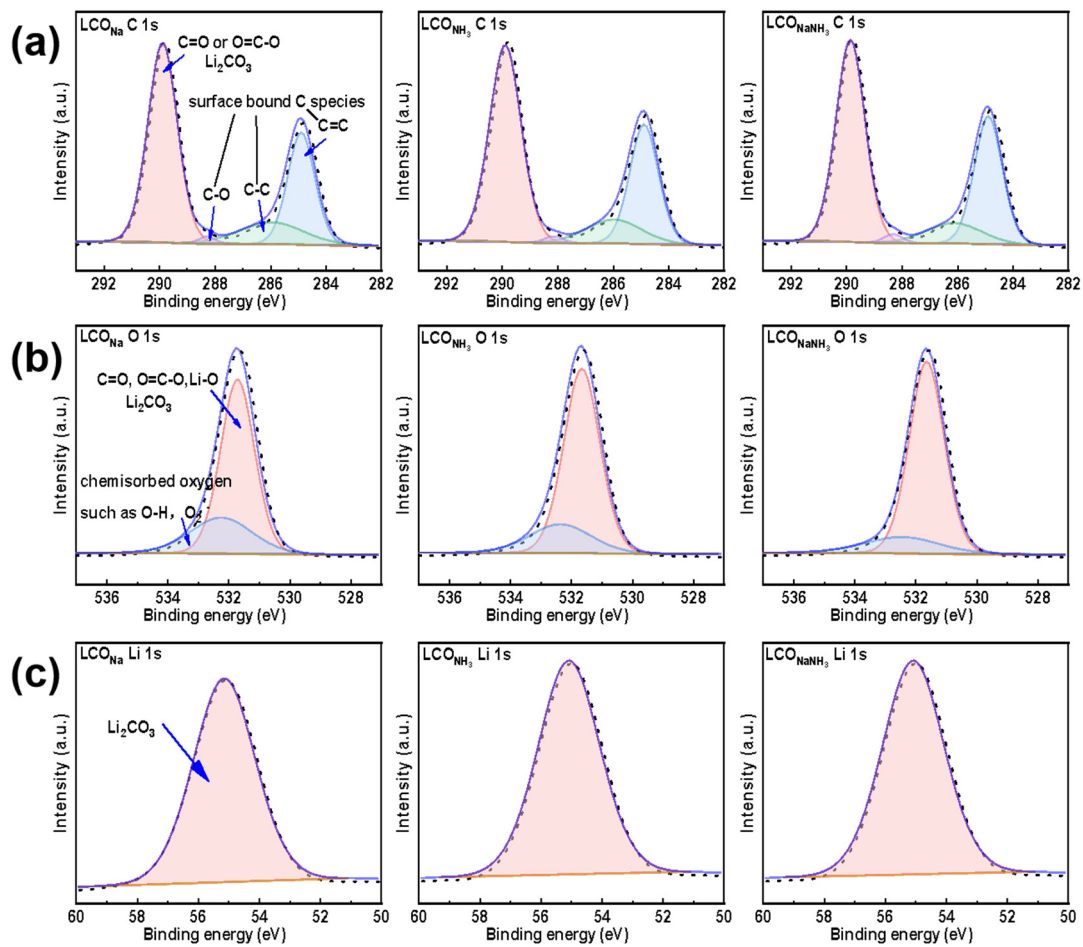


Figure S3. XPS spectrum of (a) C 1s, (b) O 1s, (c) Li 1s in  $\text{LCO}_{\text{Na}}$ ,  $\text{LCO}_{\text{NH}_3}$  and  $\text{LCO}_{\text{NaNH}_3}$ .

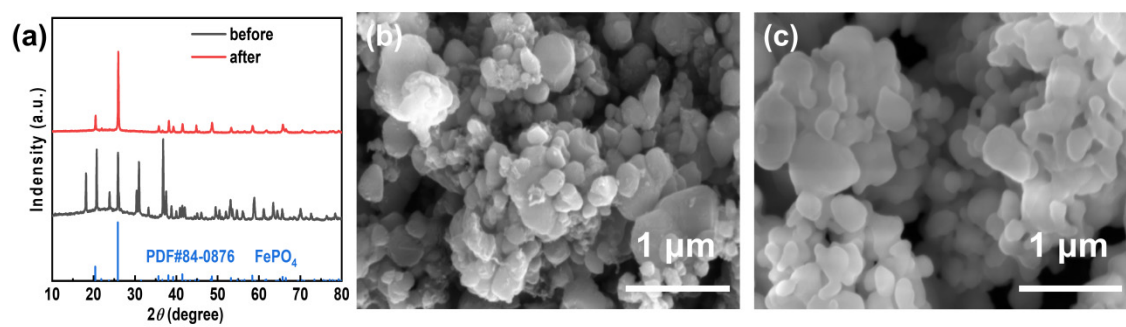


Figure S4. (a) XRD and SEM (b) before sintering and (c) after sintering of FePO<sub>4</sub>.

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Table S1 ICP-OES analysis of the SLFP.

Elements	Fe	P	Li	Al	Ca	Cu	K	Mg	Mn	Na	Ni	Pb	Si	Zn
Mass ration (%)	32.57	18.72	4.22	0.613	0.059	0.041	0.004	0.010	0.053	0.024	0.023	0.001	0.014	0.002

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Table S2. The result data of purified Li<sup>+</sup>-containing liquid by adding purification reagent (NaOH).

pH	Mass of elemental impurities (mg)											
	Al	Ca	Cu	Fe	K	Mg	Mn	Na	Ni	Pb	Si	Zn
2	1.97	0.59	0.67	0.16	0.10	0.11	1.81	0.42	0.64	0.00	0.09	0.02
3	1.96	0.58	0.64	0.03	0.08	0.11	1.80	5.34	0.60	0.00	0.54	0.02
4	1.05	0.49	0.61	0.00	0.08	0.10	1.80	8.10	0.58	0.00	0.56	0.02
5	0.48	0.46	0.45	0.00	0.10	0.10	1.80	9.01	0.58	0.00	0.57	0.01
6	0.08	0.33	0.07	0.00	0.10	0.09	1.47	10.34	0.51	0.00	0.58	0.00
7	0.01	0.28	0.01	0.00	0.11	0.09	0.89	11.56	0.35	0.00	0.58	0.00
8	0.01	0.22	0.00	0.00	0.11	0.08	0.31	12.37	0.10	0.00	0.53	0.00
9	0.10	0.15	0.00	0.00	0.12	0.07	0.01	12.65	0.01	0.00	0.36	0.00
10	0.72	0.09	0.00	0.00	0.12	0.04	0.01	12.99	0.00	0.00	0.35	0.00
11	1.58	0.06	0.00	0.00	0.13	0.00	0.00	14.35	0.00	0.00	0.74	0.00

Table S3. The result data of purified  $\text{Li}^+$ -containing liquid by adding purification reagent ( $\text{NH}_3 \cdot \text{H}_2\text{O}$ ).

pH	Mass of elemental impurities (mg)											
	Al	Ca	Cu	Fe	K	Mg	Mn	Na	Ni	Pb	Si	Zn
2	1.97	0.59	0.67	0.16	0.10	0.11	1.81	0.42	0.64	0.00	0.09	0.02
3	1.97	0.56	0.67	0.06	0.05	0.11	1.77	0.37	0.63	0.00	0.09	0.02
4	1.05	0.55	0.64	0.00	0.10	0.11	1.77	0.40	0.62	0.00	0.09	0.02
5	0.38	0.52	0.39	0.00	0.08	0.11	1.76	0.40	0.62	0.00	0.09	0.02
6	0.03	0.40	0.06	0.00	0.08	0.10	1.61	0.40	0.58	0.00	0.09	0.00
7	0.02	0.36	0.01	0.00	0.08	0.10	1.18	0.40	0.47	0.00	0.09	0.00
8	0.03	0.29	0.01	0.00	0.07	0.10	0.39	0.39	0.21	0.00	0.08	0.00
9	0.13	0.18	0.01	0.00	0.07	0.08	0.04	0.39	0.04	0.00	0.06	0.00
10	1.37	0.14	0.32	0.00	0.09	0.05	0.02	0.35	0.28	0.00	0.08	0.00
11	1.91	0.11	0.59	0.00	0.10	0.01	0.01	0.37	0.39	0.00	0.16	0.02



Table S4. Composition analysis of different  $\text{Li}_2\text{CO}_3$ .

Impurity	Ratio of $\text{Li}_2\text{CO}_3$ (%)		
	$\text{LCO}_{\text{Na}}$	$\text{LCO}_{\text{NH}_3}$	$\text{LCO}_{\text{NaNH}_3}$
Al	0.0001	0.0002	0.0001
Ca	0.0018	0.0274	0.0048
Cu	0.0000	0.0006	0.0000
Fe	0.0003	0.0001	0.0004
K	0.0005	0.0008	0.0005
Mg	0.0007	0.0048	0.0021
Mn	0.0000	0.0433	0.0000
Na	0.0018	0.0015	0.0016
Ni	0.0001	0.0236	0.0008
Pb	0.0001	0.0001	0.0000
Si	0.0255	0.0029	0.0029
Zn	0.0001	0.0003	0.0002
$\text{Li}_2\text{CO}_3$	99.35	97.18	99.51

Table S5 Composition analysis of the FePO<sub>4</sub>.

Test item	Fe	P	Fe:P	Al	Ca	Cu	K	Mg	Mn	Na	Ni	Pb	Si	Zn
Mass ratio (%)	36.42	20.70	0.98	0.0718	0.0137	0.0346	0.0061	0.0079	0.0163	0.0429	0.0141	0.0034	0.0307	0.0057