Supplementary Information (SI) for Journal of Materials Chemistry A.

Supporting Information

Advances and Industrialization of $LiFePO_4$ Cathodes in Electric Vehicles: Challenges, Innovations, and Future Directions

Yongda Guo,[a] Qifu Zhang,[a] Junzheng Wei,[a] Yating Hu,[*a] Ximeng Liu,[*b,c] Shaomin Huang[*d] and Chunlei Pang[c]

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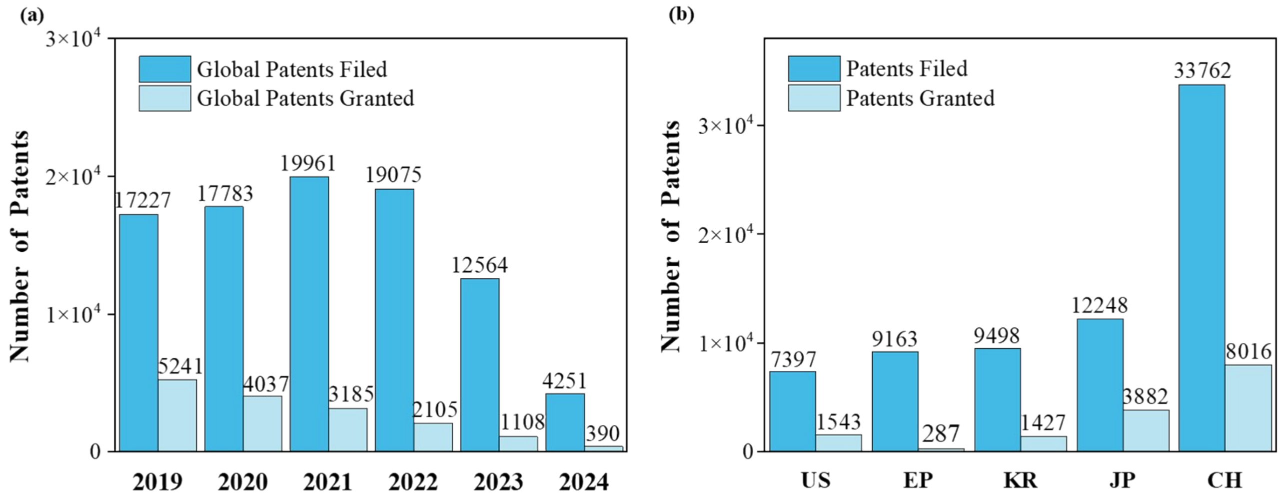

Fig. S1. (a)Total number of patents filed and granted worldwide for $LiFePO_4$ materials each year from 2019 to 2024; (b)Total number of patents filed and granted for $LiFePO_4$ materials in China, the USA, Japan, Korea, and Europe from 2019 to 2024.
(data from Google patents: https://patents.google.com/)

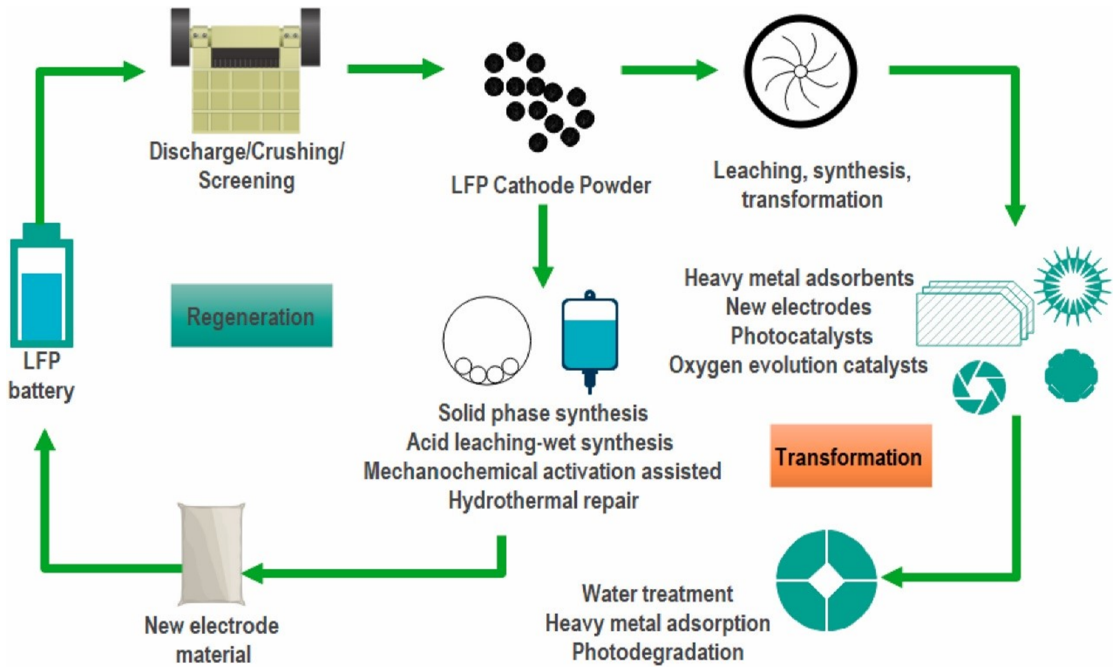

Fig. S2. Schematic diagram of regeneration and transformation of functional materials of LFP($LiFePO_4$)batteries.[1] Copyright 2022 Royal Society of Chemistry.

Tables

Table S1. Various LIB battery for EVs.

Cell chemistry	Cells			Battery packs		EV model
	Producer	Voltage (V)	Energy density (Wh kg^{-1})	Energy (kWh)	Range (km)	
LFP						
LFP/C	CATL	3.2	125	62.5	634	Tesla Model 3(2025)
LFP/C	BYD	3.2	140	48	420	BYD Qin PLUS EV (2025)
LFP/C	BYD	3.2	\	73.6	700	Xiaomi SU7 EV (2024)
LFP/C	Ningde E-con Power System Co., Ltd	3.2	140	49	415	MG4 EV (2023)
NMC						
NMC/C	SAIC-CATL	3.7	\	52.8	425	D.4 X Smart Pure Edition (2025)
NMC/C	CATL	3.7	255	101	800	Xiaomi SU7 MAX (2024)
NCA						
NCA/C	Panasonic	3.66	254	100	715	Tesla Model S (2023)
NCA/C	Panasonic	3.66	243	100	700	Tesla Model X (2023)
SIB						
SIB/C	CATL	\	146.05	14.07	170	Chery QQ IceCream (2024)

LPF: $LiFePO_4$, NMC: $LiNi_xMn_yCo_{1-x-y}O_2$, NCA: $LiNi_{0.8}Co_xAl_{0.2-x}O_2$, SIB: Sodium-ion battery. C: graphite, Date from PCauto (https://www.pcauto.com.cn/)

Table S2. Synthesis of new batteries or functional materials from cathode materials of used LFP batteries.[1-3]

Application	Method	Application Scenario
Regenerated LFP cathode material	Regeneration to New Battery by High temperature solid-state reaction	Initial capacity of 163.2 mA h g^{-1} at the rate of 0.1 C. Capacity retention of 97.08% at a rate of 0.5 C after 100 cycles.
	Acid leaching and hydrothermal synthesis	Discharge capacity of 136 mA h g^{-1} at the rate of 0.1 C. Capacity retention of 98.6 % at a rate of 1C after 300 cycles.
	Lithium iodide solution re-lithiation	Capacity of 145 mA h g-1 at the rate of 1C Capacity retention of 96% at 5C after 300 cycles.
Heavy metal adsorbent	Direct useing	Water treatment: SLFP shows adsorption capacities of 44.28, 39.54, 25.63, and 27.34 mg g^{-1} for Cu^{2+}, Pb^{2+}, Cd^{2+} and Zn^{2+}, respectively.
Fe_2O_3/ $Co_3(PO_4)_2$ Photoanodes	Electrochemical recycling method and Fe films deposition	Water Oxidation: Power conversion efficiencies for water oxidation at 0.13 % in 1 M NaOH.
Catalysts for oxygen evolution reaction	Wetness impregnation method	A low overpotential of 285 mV at 10 mA cm^{-2}

LFP: $LiFePO_4$, SLFP: Spent $LiFePO_4$.

References

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