신기술-신산업관련 동향 리뷰

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논문제목	Direct Recycling of Degraded $LiFePO_4$ Cathode Material via Natural Electron Donors Healing and Targeted Surface Reconstruction
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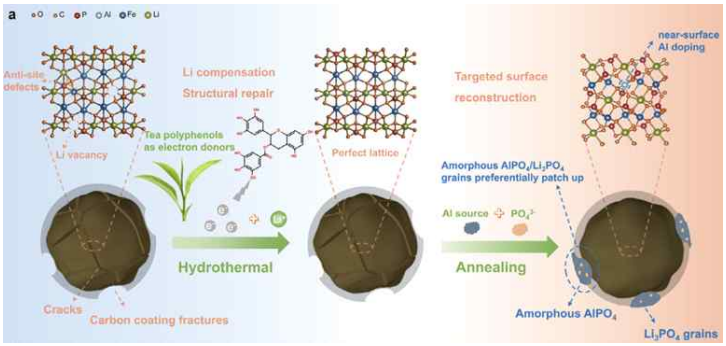
초록	Direct regeneration of spent cathode materials is crucial for the sustainable development of the new energy vehicle industry. However, owing to the lack of targeted surface repair strategies, the regenerated $LiFePO_4$ (LFP) always faces some issues, such as Fe ions re-migration and sluggish Li+ diffusion, or a serious trade-off between restored specific capacity and stability. Herein, an integrated bulk and surface restoration strategy is proposed to regenerate spent LFP (S-LFP) via using natural tea polyphenols as electron donors to reduce Fe (III) phase and heal anti-site defects in the bulk, and introducing a hybrid $AlPO_4/Li_3PO_4$ (AP/LP) patching coating at the fracture of carbon layer on LFP for targeted surface reconstruction, accompanied by Al doping into the bulk LFP. Theoretical calculations reveal that AP/LP patching coating forms a dual electron- and ion-conducting layer with the residual carbon layer, coupling with strengthened Fe—O bonding by Al doping, to improve kinetics and stability of LFP during cycling. The optimized regenerated LFP cathode exhibits a capacity of 124.3 mAh g−1 after 400 cycles at 2C with a capacity retention of 92.1%. This scalable healing and stabilizing strategy have large potential to strike a balance between specific capacity repairing and stability improvement in the regeneration process.

	
주제어(키워드)	Direct recycling, $AlPO_4/Li_3PO_4$-coating, targeted surface reconstruction, natural electron donor
요약 **(국문 혹은 영문)**	Tea polyphenols을 이용한 수열 relithiation으로 리튬 손실 및 구조 결함을 복원하였으며, $AlPO_4/Li_3PO_4$의 선택적 패치 코팅과 Al 도핑을 통해 손상된 코팅층과 구조 안정성을 개선하였다. 재생된 LFP는 5C와 10C에서 각각 118.6 mAh g^{-1}와 106.2 mAh g^{-1}의 우수한 고율 성능과 400회 사이클 후 92.1%의 높은 용량 유지율을 나타냈다.