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research highlights

SOLAR STORAGE

Two-electrode single systems

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Simultaneous conversion and storage of solar energy is attractive, but simple combination of a solar cell and a battery often leads to low photoelectric conversion and storage efficiency. To improve the energy harvesting efficiency, a promising strategy is to integrate a photoelectrode into a rechargeable battery in a single device, in which the photoelectrode captures the solar energy and the photogenerated electrons and holes facilitate the (dis)charging process. Nevertheless, this type of system often requires three electrodes, increasing the design complexity and cost. George Demopoulos, Karim Zaghib and colleagues in Canada, Italy, UK and Spain, have now reported a two-electrode photoassisted energy storage system that consists of a dye-sensitized $LiFePO_4$ hybrid photocathode, a lithium anode and an electrolyte with $LiPF_6$ carbonate solvents.

Under illumination, the dye in the hybrid photocathode, N719, which is commonly used in dye-sensitized solar cells, absorbs photons, generating electrons and holes. While $LiFePO_4$ is oxidized by the holes leading to delithiation of $LiFePO_4$ to $FePO_4$, the photogenerated electrons undergo complex reactions: they first reduce gaseous oxygen into peroxide or superoxide species, which in turn react with the electrolyte's carbonate components, forming a solid–electrolyte interface (SEI) layer at the surface of the Li metal anode. Upon discharge, the SEI dissolves and Li ions are transferred to the cathode, restoring $LiFePO_4$. The researchers demonstrate 15 cycles of photocharging and galvanostatic discharging with the two-electrode cell. However, as the electrolyte and the Li metal are both consumed during the process, improvements are required to improve the cyclability of the photorechargeable batteries. In addition, the combined photoconversion and storage efficiency of the cell is quite low, 0.06–0.08%, suggesting that the $LiFePO_4$/dye/electrolyte interface needs to be optimized to avoid large charge recombination losses. ❐

Changjun Zhang