Photo accelerated fast charging of lithium ion batteries

What is a Photo-accelerated lithium-ion battery cell?
The principle of a photo-accelerated lithium-ion battery cell. The cell consists of a transparent window, current collector, cathode, electrolyte, separator, and anode.

How does light affect lithium-ion battery recharging?
We report here that illumination of a spinel-type LiMn 2 O 4 cathode induces efficient charge-separationleading to fast lithium-ion battery charging. The discovery that exposure of LMO to light lowers charge transport resistance can lead to new fast recharging battery technologies for consumer applications and battery-only electric vehicles.

Could a slow-charged lithium-ion battery be a new recharging technology?
We anticipate that this discovery could pave the way to the development of new fast recharging battery technologies. Lithium-ion batteries (LIBs) must be slow-charged in order to restore the full capacity (stored energy) of the battery, as well as to promote longer battery cycle life.

How does LiMn2O4 light affect battery charging time?
We find that a direct exposure of light to an operating LiMn2O4 cathode during charging leads to a remarkable loweringof the battery charging time by a factor of two or more. This enhancement is enabled by the induction of a microsecond long-lived charge separated state,consisting of Mn4+(hole) plus electron.

Does white light affect the charging rate of a LiMn2O4 cathode?
Here we show that the charging rate of a cathode can be dramatically increasedvia interaction with white light. We find that a direct exposure of light to an operating LiMn2O4 cathode during charging leads to a remarkable lowering of the battery charging time by a factor of two or more.

Are lithium-ion batteries a problem?
Due to their exceptional high energy density,lithium-ion batteries are of central importance in many modern electrical devices. A serious limitation,however,is the slow charging rateused to obtain the full capacity. Thus far,there have been no ways to increase the charging rate without losses in energy density and electrochemical performance.

Abstract. Due to their exceptional high energy density, lithium-ion batteries are of central importance in many modern electrical devices. A serious limitation, however, is the slow charging rate used to obtain the full capacity.

Here we show that the charging rate of a cathode can be dramatically increased via interaction with white light. We find that a direct exposure of light to an operating LiMn2O4 cathode during ...

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Delivering lithium ion batteries capable of fast charging without suffering from accelerated degradation is an important milestone for transport electrification. Recently, there has been growing interest in applying data-driven methods for optimising fast charging protocols to avoid accelerated battery degradation.

Photo-accelerated fast charging of lithium-ion batteries. Nat. Commun., 10 (2019), p. 4946, 10.1038/s41467-019-12863-6. ... Multiplying light harvest driven by hybrid-reflections 3D electrodes achieves high-Availability photo-charging zinc-ion batteries. Adv. Energy Mater., 13 (2023), Article 2204058, 10.1002/aenm.202204058.

ARTICLE Photo-accelerated fast charging of lithium-ion batteries Anna Lee 1, Márton Vörös 2, Wesley M. Dose 1, Jens Niklas 1, Oleg Poluektov 1, Richard D. Schaller 3, Hakim Iddir1, Victor A ...

Here the authors show that illumination of a lithium manganese oxide cathode can induce efficient charge-separation and electron transfer processes, thus giving rise to a new type of fast ...

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Photo-accelerated fast charging of lithium-ion batteries. Anna Lee Márton Vörös +9 authors Christopher S. Johnson. Materials Science, Physics. ... thus giving rise to a new type of fast lithium-ion battery charging. Expand. 71. PDF. Save. ...

Lithium-ion batteries with nickel-rich layered oxide cathodes and graphite anodes have reached specific energies of 250-300 Wh kg-1 (refs. 1,2), and it is now possible to build a 90 kWh ...

The principle of a photo-accelerated lithium-ion battery cell. The cell consists of a transparent window, current collector, cathode, electrolyte, separator, and anode. The broadband white light is used with an IR filter to avoid undesired heating of the cell. ... Brian Ingram, Larry A. Curtiss & Christopher S. Johnson (2019) "Photo ...

This research appeared in Nature Communications, titled "Photo-accelerated fast charging of lithium-ion batteries." In addition to Johnson, other Argonne contributors are Anna Lee, Márton Vörös ...

cathode induces efficient charge-separation leading to fast lithium-ion battery charging. The discovery that exposure of LMO to light lowers charge transport resistance can lead to new

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These so-called accelerated charging modes are based on the CCCV charging mode newly added a high-current CC or constant power charging process, so as to achieve the purpose of reducing the charging time Research has shown that the accelerated charging mode can effectively improve the charging efficiency of lithium-ion batteries, and at the ...

The development of photo-enhanced lithium-ion batteries, where exposing the electrodes to light results in higher capacities, higher rate performance or self-charging, has recently gained substantial traction. The challenge in these ...

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LiMn2O4 cathode photo-accelerated fast charging with deformations in local structure Recently, it has been demonstrated that white light illumination of LiMn 2O 4 ... Improved fast charging of lithium-ion batteries (LIBs) is of critical importance for increased electric vehicle adoption, as slow vehicle charging is one of the largest ...

Lee A, Vörös M, Dose WM et al (2019) Photo-accelerated fast charging of lithium-ion batteries. Nat Commun 10:4946. Article PubMed PubMed Central ADS Google Scholar Kang H, Kim H, Park MJ (2018) Sulfur-rich polymers with functional linkers for high-capacity and fast-charging lithium-sulfur batteries.

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New generation of lithium-ion batteries (LIBs) integrating solar energy conversion and storage is emerging, as they could solve the fluctuation problem in the utilization of solar energy. Photo-rechargeable lithium-ion batteries (PR-LIBs) are ideal devices for such target, in which solar energy is converted into electricity and stored in LIB. In order to achieve the high ...

Lithium-ion battery (LIB) design is the predominant technology to power portable and mobile electric devices/equipment. Fast charging and self-powering of LIBs are significant but challenging features to be addressed for meeting the fast-paced society and emerging demands. Herein, we report a rational photorechargeable lithium-ion battery (photo-LIB) design using ...

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Conventional fast-charging using a high constant current can ultimately accelerate uncontrolled Li plating on the graphite anode, resulting in degradation and poor cycle life of Li-ion batteries (LIBs). Therefore, identifying suitable fast-charging methods for LIBs is beneficial for the widespread use of electric vehicles (EVs).

This research appeared in Nature Communications, titled "Photo-accelerated fast charging of lithium-ion batteries." In addition to Johnson, other Argonne contributors are Anna Lee, Márton Vörös, Wesley M. Dose, Jens Niklas, Oleg Poluektov, Richard D. Schaller, Hakim Iddir, Victor A. Maroni, Eungje Lee, Brian Ingram, and Larry A. Curtiss.

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The accelerated charging of lithium-ion cells is proposed as a case study that will facilitate the integration of several fundamental electrochemical concepts learned during a dedicated electrochemistry course. Lithium-ion cells are ubiquitous to our everyday life, and their presence will become even more pervading with the increase in number of electric vehicles ...