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IN THIS ISSUE

ISSN 1754-5692 CODEN EESNBY 9(5) 1517-1852 (2016)



Cover

See Paul J. Dauenhauer *et al.*, pp. 1645–1649. Image reproduced by permission of Paul Dauenhauer from *Energy Environ. Sci.*, 2016, 9, 1645.



Inside cover

See Klaus Rademann *et al.*, pp. 1528–1532. Image reproduced by permission of Klaus Rademann from *Energy Environ. Sci.*, 2016, 9, 1528. Background image courtesy NASA/Reto Stöckli and Robert Simmon.

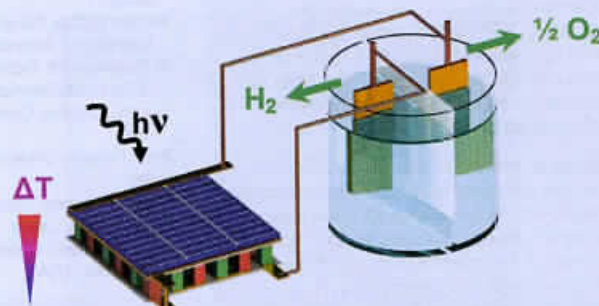
OPINION

1528

Thermoelectricity in the context of renewable energy sources: joining forces instead of competing

Virgil Andrei, Kevin Bethke and Klaus Rademann*

3-in-1: combining thermoelectrics, photovoltaics and water splitting catalysts in one device.



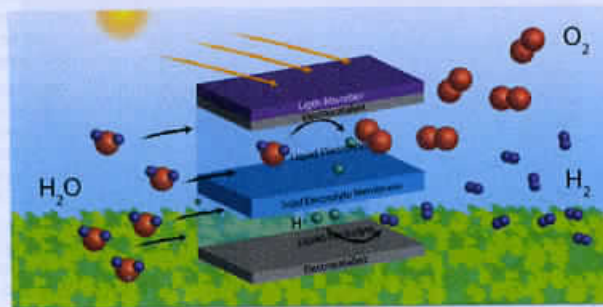
REVIEWS

1533

Mass transport aspects of electrochemical solar-hydrogen generation

Miguel A. Modestino,* S. Mohammad H. Hashemi and Sophia Haussener

The conception of practical solar-hydrogen generators requires the implementation of engineering design principles that allow photo-electrochemical material systems to operate efficiently, continuously and stably over their lifetime.



1552

High-efficiency crystalline silicon solar cells: status and perspectives

Corsin Battaglia,* Andres Cuevas and Stefaan De Wolf

This article reviews key factors for the success of crystalline silicon photovoltaics and gives an update on promising emerging concepts for further efficiency improvement and cost reduction.

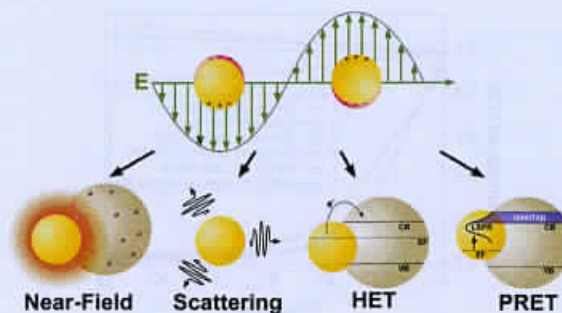


1577

Light trapping in mesoporous solar cells with plasmonic nanostructures

William R. Erwin, Holly F. Zarick, Eric M. Talbert and Rizia Bardhan*

This review article provides a comprehensive review of recent progress in plasmon-enhanced mesoporous solar cells and the mechanisms employed.



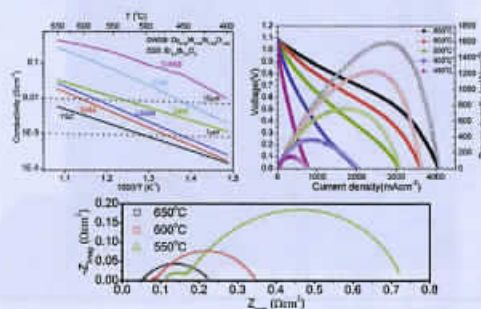
PERSPECTIVE

1602

A perspective on low-temperature solid oxide fuel cells

Zhan Gao, Liliana V. Mogni, Elizabeth C. Miller, Justin G. Railsback and Scott A. Barnett*

This article provides a perspective review of low-temperature solid oxide fuel cells research and development.



COMMUNICATIONS

1645

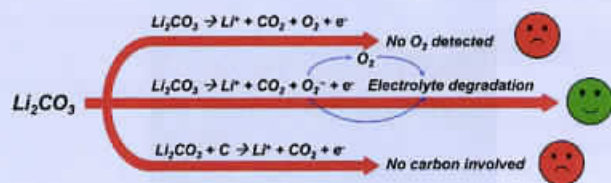
Micro-ratcheted surfaces for a heat engine biomass conveyor

Christoph Krumm, Saurabh Maduskar, Alex D. Paulsen, Anthony D. Anderson, Nicholas L. Barberio, Jonathan N. Damen, Connor A. Beach, Satish Kumar and Paul J. Dauenhauer*

Biomass particles spontaneously self-propel in the direction of asymmetric ratchets above the reactive Leidenfrost temperature.



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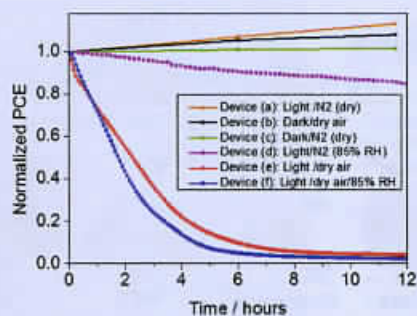


Exploring the electrochemical reaction mechanism of carbonate oxidation in Li-air/ CO_2 battery through tracing missing oxygen

Sixie Yang, Ping He* and Haoshen Zhou*

Superoxide radicals are generated during the electrochemical decomposition of Li_2CO_3 . The existence of superoxide radicals will lead to the degradation of the tetraglyme electrolyte.

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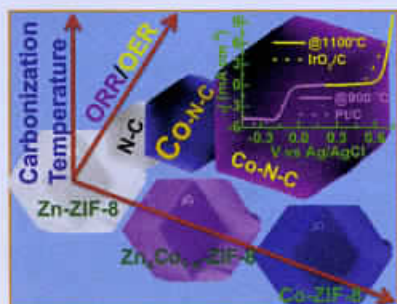


Light and oxygen induced degradation limits the operational stability of methylammonium lead triiodide perovskite solar cells

Daniel Bryant, Nicholas Aristidou, Sebastian Pont, Irene Sanchez-Molina, Thana Chotchunangatchaval, Scot Wheeler, James R. Durrant and Saif A. Haque*

Here, we demonstrate that light and oxygen-induced degradation is the main reason for the low operational stability of methylammonium lead triiodide ($\text{MeNH}_3\text{PbI}_3$) perovskite solar cells exposed to ambient conditions.

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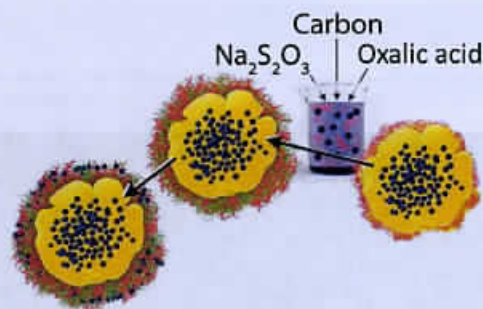


Switching effective oxygen reduction and evolution performance by controlled graphitization of a cobalt-nitrogen-carbon framework system

Srinivas Gadipelli,* Tingting Zhao, Stephen A. Shevlin and Zhengxiao Guo*

Effective oxygen reduction/evolution nanoporous cobalt-nitrogen-carbon based catalysts are developed from rationally designed single-precursor $\text{Co}_x\text{Zn}_{100-x}\text{-ZIF-8}$ with controlled graphitization.

1668



The design of nanostructured sulfur cathodes using layer by layer assembly

Naoki Osada, Claudiu B. Bucur, Hikaru Aso and John Muldoon*

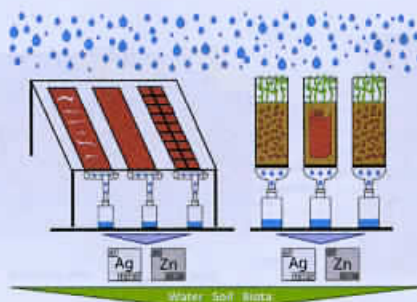
A polyelectrolyte multilayer based sulfur cathode.

1674

Outdoor fate and environmental impact of polymer solar cells through leaching and emission to rainwater and soil

Nieves Espinosa, Yannick-Serge Zimmermann, Gisele A. dos Reis Benatto, Markus Lenz and Frederik C. Krebs*

Failure during operation and end-of life management through land filling demonstrated the emission of constituents (Ag and Zn) to the environment.

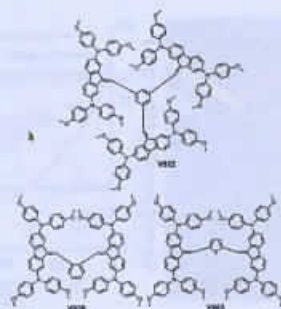


1681

Branched methoxydiphenylamine-substituted fluorene derivatives as hole transporting materials for high-performance perovskite solar cells

Tadas Malinauskas,* Michael Saliba,* Taisuke Matsui, Maryte Daskeviciene, Simona Urnikaite, Paul Gratia, Robert Send, Henrike Wonneberger, Ingmar Bruder, Michael Graetzel, Vytautas Getautis* and Mohammad Khaja Nazeeruddin*

Small-molecule fluorene HTMs were synthesized and tested in perovskite solar cell, PCE of up to 19.96% was reached.



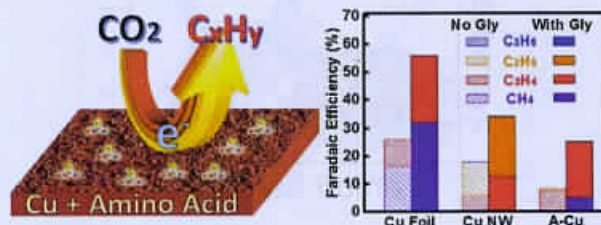
PAPERS

1687

Amino acid modified copper electrodes for the enhanced selective electroreduction of carbon dioxide towards hydrocarbons

Ming Shi Xie, Bao Yu Xia, Yawei Li, Ya Yan, Yanhui Yang, Qiang Sun, Siew Hwa Chan, Adrian Fisher and Xin Wang*

Amino acid functionalized Cu nanowire (NW) film electrode exhibits remarkably enhanced selectivity of hydrocarbons during CO₂ electroreduction, by stabilizing the key intermediate CHO.

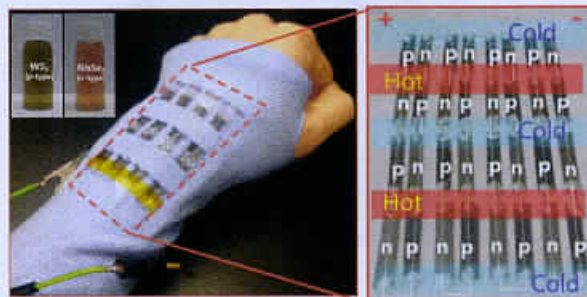


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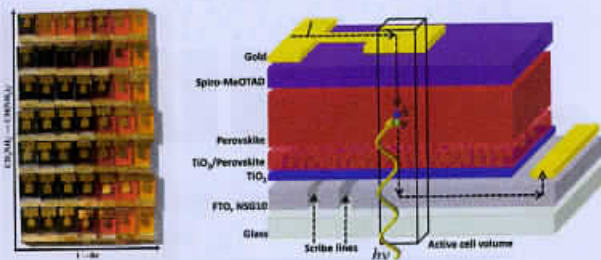
Chemically exfoliated transition metal dichalcogenide nanosheet-based wearable thermoelectric generators

Jin Young Oh, Ji Hoon Lee, Sun Woong Han, Soo Sang Chae, Eun Jin Bae, Young Hun Kang, Won Jin Choi, Song Yun Cho, Jeong-O Lee, Hong Koo Baik* and Tae Il Lee*

A wearable thermoelectric generator, woven on a wristband, consisting of chemically exfoliated n- and p-type transition metal dichalcogenide nanosheets.



1706

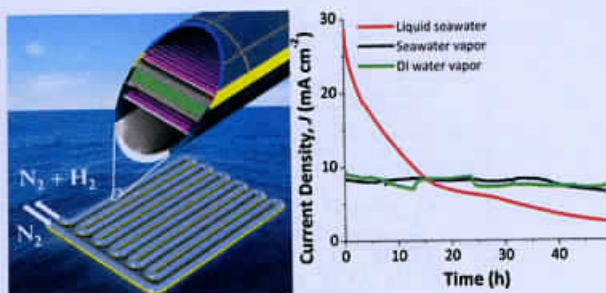


Exploration of the compositional space for mixed lead halogen perovskites for high efficiency solar cells

T. Jesper Jacobsson,* Juan-Pablo Correa-Baena, Meysam Pazoki, Michael Saliba, Kurt Schenk, Michael Grätzel and Anders Hagfeldt*

A systematic investigation of the compositional space for perovskite solar cells spanned by MAPbI_3 , MAPbBr_3 , FAPbI_3 and FAPbBr_3 .

1725

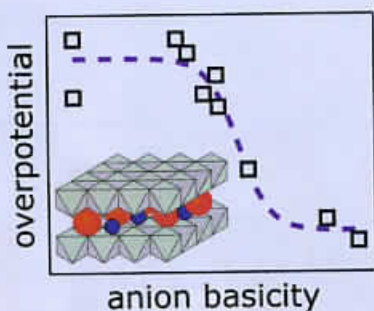


Solar hydrogen production from seawater vapor electrolysis

Sudesh Kumari, R. Turner White, Bijandra Kumar and Joshua M. Spurgeon*

Solar photovoltaic utilities require large land areas and also must be coupled to cost-effective energy storage to provide reliable, continuous energy generation. To target both of these disadvantages, a method was demonstrated to produce hydrogen fuel from solar energy by splitting seawater vapor from ambient humidity at near-surface ocean conditions.

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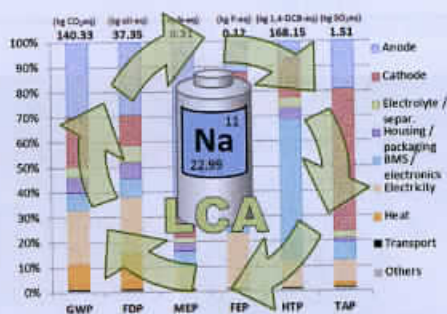


Effect of interlayer anions on [NiFe]-LDH nanosheet water oxidation activity

B. M. Hunter, W. Hieringer, J. R. Winkler, H. B. Gray and A. M. Müller*

Water oxidation activity of nickel-iron layered double hydroxide ([NiFe]-LDH) nanosheet electrocatalysts is a function of interlayer anion basicity.

1744



Life cycle assessment of sodium-ion batteries

Jens Peters,* Daniel Buchholz, Stefano Passerini* and Marcel Weil

Life cycle assessment for the production of a sodium-ion battery with a layered transition metal oxide and hard carbon.

1752

Grain boundary polycrystalline perovskite solar cells

Yuchuan Wang, Qingfeng Haotian, Jeffery J. Goldberger, Grain boundary dominated organic-inorganic hybrid perovskite solar cells

1760

A low-temperature battery

Xinwei Chen, Frank Y. C. Boey, Alexander W. Craig, Redox flow battery energy storage systems such as vanadium redox flow battery

1771

Nickel selenide oxygen evolution catalyst

A. T. Swales, Ni₃Se₂ hydroxide evolution catalyst stability

1783

A nanostructured operating ambient

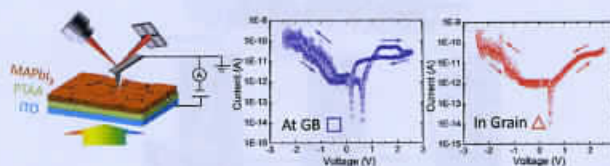
P. Tan, Z. Li, A cathode nanosheet evolution of the solid aqueous ambient

1752

Grain boundary dominated ion migration in polycrystalline organic–inorganic halide perovskite films

Yuchuan Shao, Yanjun Fang, Tao Li, Qi Wang, Qingfeng Dong, Yehao Deng, Yongbo Yuan, Haotong Wei, Meiyu Wang, Alexei Gruverman, Jeffery Shield and Jinsong Huang*

Grain boundaries have been demonstrated as the dominating ion migration channels in polycrystalline organic–inorganic halide perovskite films.



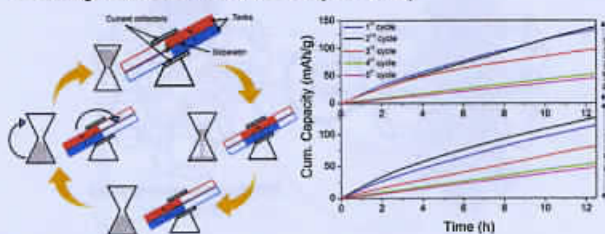
1760

A low-dissipation, pumpless, gravity-induced flow battery

Xinwei Chen, Brandon J. Hopkins, Ahmed Helal, Frank Y. Fan, Kyle C. Smith, Zheng Li, Alexander H. Slocum, Gareth H. McKinley, W. Craig Carter and Yet-Ming Chiang*

Redox flow batteries have the potential to provide low-cost energy storage to enable renewable energy technologies such as wind and solar to overcome their inherent intermittency and to improve the efficiency of electric grids.

Gravity-Induced Flow Cell (GIFcell)

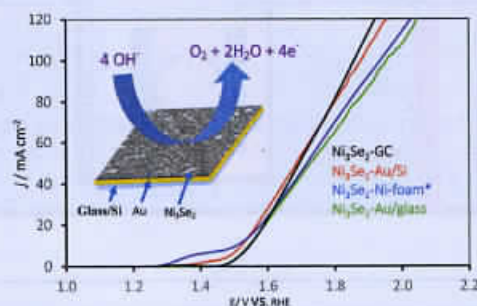


1771

Nickel selenide as a high-efficiency catalyst for oxygen evolution reaction

A. T. Swesi, J. Masud and M. Nath*

Ni_3Se_2 has been identified as a high-efficiency oxygen evolution catalyst with low onset potential and extended stability under alkaline conditions.

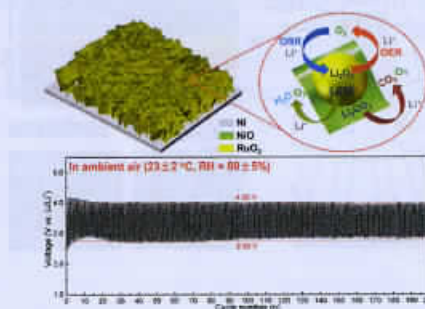


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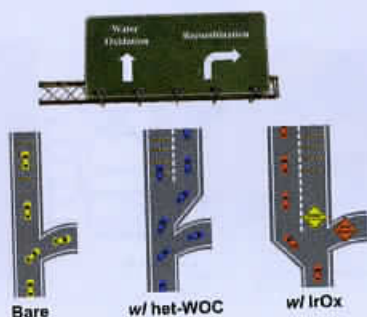
A nano-structured RuO_2/NiO cathode enables the operation of non-aqueous lithium–air batteries in ambient air

P. Tan, Z. H. Wei, W. Shyy, T. S. Zhao* and X. B. Zhu

A cathode composed of RuO_2 nanoparticle-decorated NiO nanosheets not only catalyzes the oxygen reduction and evolution reactions, but also promotes the decomposition of the side products (LiOH and Li_2CO_3), enabling a non-aqueous lithium–air battery to be truly operated in ambient air.



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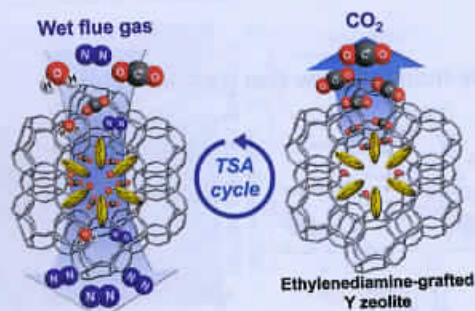


Comparison of heterogenized molecular and heterogeneous oxide catalysts for photoelectrochemical water oxidation

Wei Li, Da He, Stafford W. Sheehan,* Yumin He, James E. Thorne, Xiahui Yao, Gary W. Brudvig* and Dunwei Wang*

Molecular and heterogeneous water oxidation catalysts improve the performance of hematite as a photoanode via fundamentally different mechanisms.

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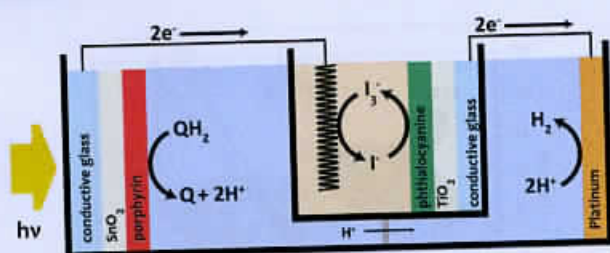


An ethylenediamine-grafted Y zeolite: a highly regenerable carbon dioxide adsorbent via temperature swing adsorption without urea formation

Chae-hoon Kim, Hae Sung Cho, Shuai Chang, Sung June Cho* and Minkee Choi*

An ethylenediamine-grafted Y zeolite effectively adsorbs CO₂ from a wet flue gas and it is highly regenerable through a temperature swing adsorption (TSA) process.

1812

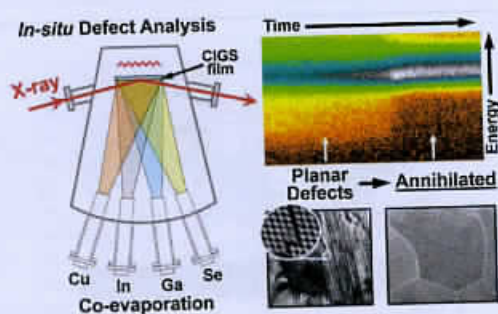


A tandem dye-sensitized photoelectrochemical cell for light driven hydrogen production

Benjamin D. Sherman,* Jesse J. Bergkamp,* Chelsea L. Brown, Ana L. Moore, Devens Gust and Thomas A. Moore

A tandem cell incorporating two dye-sensitized photoanodes produces H₂ from hydroquinone using only light energy and no applied electrical bias.

1818



Annihilation of structural defects in chalcogenide absorber films for high-efficiency solar cells

Roland Mainz,* Ekin Simsek Sanli, Helena Stange, Doron Azulay, Stephan Brunken, Dieter Greiner, Shir Hajaj, Marc D. Heinemann, Christian A. Kaufmann, Manuela Klaus, Quentin M. Ramasse, Humberto Rodriguez-Alvarez, Alfons Weber, Isaac Balberg, Oded Millo, Peter A. van Aken and Daniel Abou-Ras

Defects rapidly annihilate near stoichiometric composition.

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From macroalgae to liquid fuel *via* waste-water remediation, hydrothermal upgrading, carbon dioxide hydrogenation and hydrotreating

A. Cole, Y. Dinburg, B. S. Haynes,* Y. He, M. Herskowitz,* C. Jazrawi, M. Landau, X. Liang, M. Magnusson, T. Maschmeyer,* A. F. Masters, N. Meiri, N. Neveux, R. de Nys,* N. Paul, M. Rabaev, R. Vidruk-Nehemya and A. K. L. Yuen

We describe an integrated process for biofuel production from low-nitrogen macroalgae involving two types of CO₂ recycling, water purification, hydrothermal processing and hydro-treating.

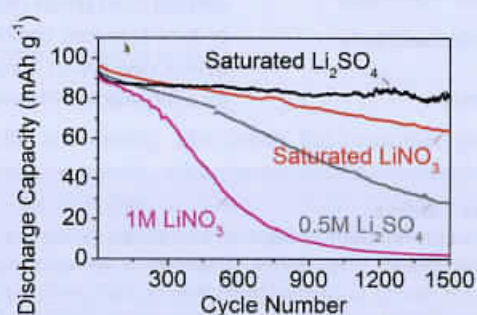


1841

Degradation and stabilization of lithium cobalt oxide in aqueous electrolytes

Anirudh Ramanujapuram, Daniel Gordon, Alexandre Magasinski, Brian Ward, Naoki Nitta, Cindy Huang and Gleb Yushin*

We report herein the exceptional cycle stability of lithium cobalt oxide (LCO) in aqueous electrolytes of high lithium salt concentrations.



CORRECTIONS

1849

Correction: Sunlight absorption in water – efficiency and design implications for photoelectrochemical devices

H. Döscher,* J. F. Geisz, T. G. Deutsch and J. A. Turner

1850

Correction: Light and oxygen induced degradation limits the operational stability of methylammonium lead triiodide perovskite solar cells

Daniel Bryant, Nicholas Aristidou, Sebastian Pont, Irene Sanchez-Molina, Thana Chotchuangchutchaval, Scot Wheeler, James R. Durrant and Saif A. Haque*