

Energy & Environmental Science

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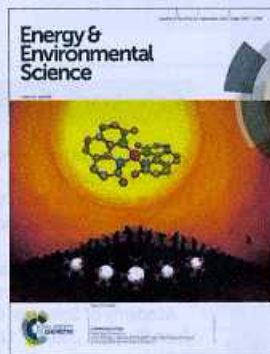
IN THIS ISSUE

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Cover

See Pingwu Du *et al.*, pp. 2668–2676.
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Inside cover

See Gerrit Boschloo *et al.*, pp. 2634–2637.
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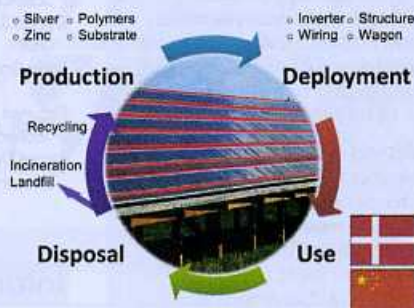
ANALYSIS

2537

Ecodesign of organic photovoltaic modules from Danish and Chinese perspectives

Nieves Espinosa, Alexis Laurent and Frederik C. Krebs*

The ecodesign of an OPV solar park is reported covering the complete life cycle: manufacturing, use and disposal stages. For the first time the life cycle inventory for such a technology is provided for its use in future LCA and EIA studies. Recommendations with the aim to influence PV policy and decision makers are given.



REVIEWS

2551

Progress and perspectives in exploiting photosynthetic biomolecules for solar energy harnessing

Sai Kishore Ravi and Swee Ching Tan*

Photosynthetic proteins are emerging as a new class of photovoltaic materials as their nature-designed architecture and internal circuitry are so sophisticated that they carry out the initial light-driven steps of photosynthesis with $\approx 100\%$ quantum efficiency.

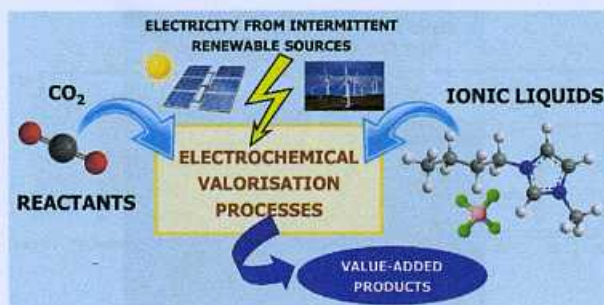


2574

Ionic liquids in the electrochemical valorisation of CO₂

Manuel Alvarez-Guerra,* Jonathan Albo, Enrique Alvarez-Guerra and Angel Irabien

This work reviews the use of ionic liquids in electrochemical approaches for the valorisation of CO₂ into value-added products, highlighting the beneficial role that ionic liquids can play in improving CO₂ electrovalorisation processes.

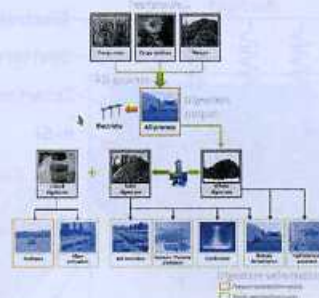


2600

New opportunities for agricultural digestate valorization: current situation and perspectives

F. Monlau,* C. Sambusiti, E. Ficara, A. Aboulkas, A. Barakat and H. Carrère

In the agricultural sector of many European countries, biogas production through anaerobic digestion (AD) is becoming a very fast-growing market necessitating to find novel valorizations routes for digestate.

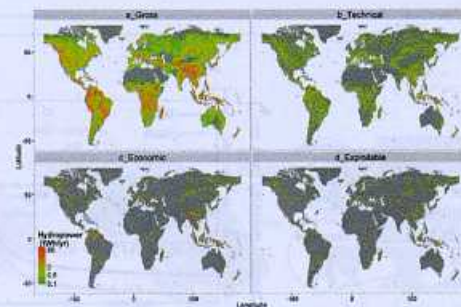


2622

A comprehensive view of global potential for hydro-generated electricity

Y. Zhou,* M. Hejazi, S. Smith, J. Edmonds, H. Li, L. Clarke, K. Calvin and A. Thomson

This study provides the first comprehensive quantification of global hydropower potential including gross, technical, economic, and exploitable estimates.



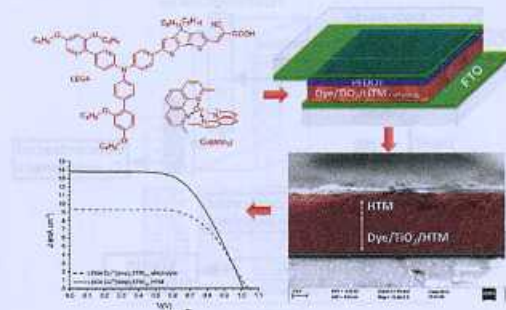
COMMUNICATIONS

2634

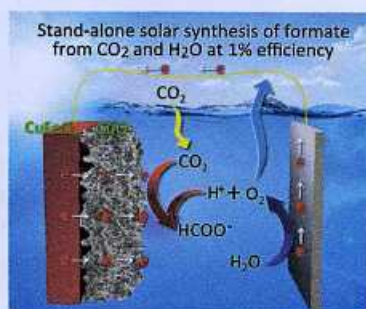
High-efficiency dye-sensitized solar cells with molecular copper phenanthroline as solid hole conductor

Marina Freitag, Quentin Daniel, Meysam Pazoki, Kári Sveinbjörnsson, Jinbao Zhang, Licheng Sun, Anders Hagfeldt and Gerrit Boschloo*

Copper phenanthroline is an efficient molecular hole transporting material for solid-state dye-sensitized solar cells. Efficiencies of more than 8% at 1 sun were obtained using LEG4 organic dye.



2638

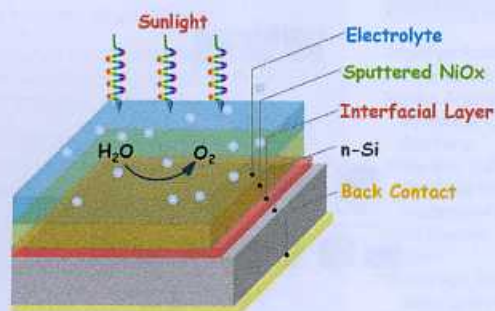


Photosynthesis of formate from CO_2 and water at 1% energy efficiency via copper iron oxide catalysis

Unseock Kang, Sung Kyu Choi, Dong Jin Ham, Sang Min Ji, Wonyong Choi, Dong Suk Han, Ahmed Abdel-Wahab and Hyunwoong Park*

Solar conversion of carbon dioxide and water to value-added chemicals remains a challenge.

2644

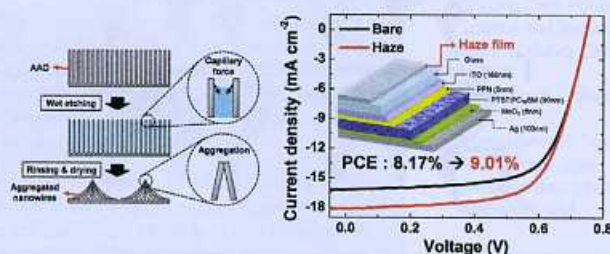


Interface engineering of the photoelectrochemical performance of Ni-oxide-coated n-Si photoanodes by atomic-layer deposition of ultrathin films of cobalt oxide

X. Zhou, R. Liu, K. Sun, D. Friedrich, M. T. McDowell, F. Yang, S. T. Omelchenko, F. H. Saadi, A. C. Nielander, S. Yalamanchili, K. M. Papadantonakis, B. S. Brunschwig and Nathan S. Lewis*

Interfacial CoO_x layers provide a route to stable, high-performance Si photoanodes for water splitting, without requiring np^+ homojunctions.

2650

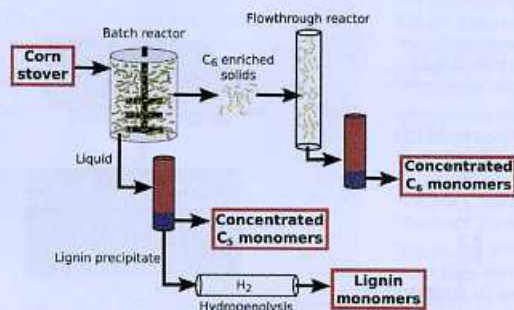


Broadband and ultrahigh optical haze thin films with self-aggregated alumina nanowire bundles for photovoltaic applications

Gumin Kang, Kyuyoung Bae, Minwoo Nam, Doo-Hyun Ko, Kyoungsik Kim* and Willie J. Padilla

Self-aggregated alumina nanowire structures have been demonstrated by anodization of aluminum and a subsequent pore breaking process for improving the power conversion efficiency of organic solar cells.

2657



Lignin monomer production integrated into the γ -valerolactone sugar platform

Jeremy S. Luterbacher, Ali Azarpira, Ali H. Motagamwala, Fachuang Lu, John Ralph and James A. Dumesic*

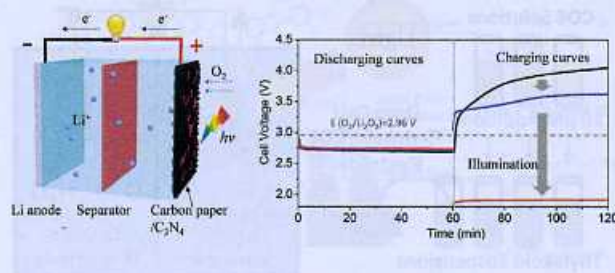
We demonstrate an experimental approach for upgrading lignin that has been isolated from corn stover via biomass fractionation using γ -valerolactone (GVL) as a solvent.

2664

Reducing the charging voltage of a Li–O₂ battery to 1.9 V by incorporating a photocatalyst

Yang Liu, Na Li,* Shichao Wu, Kaiming Liao, Kai Zhu, Jin Yi and Haoshen Zhou*

A photoassisted chargeable Li–O₂ battery is developed by integrating a g-C₃N₄ photocatalyst, which delivers an ultralow charging voltage of 1.9 V.



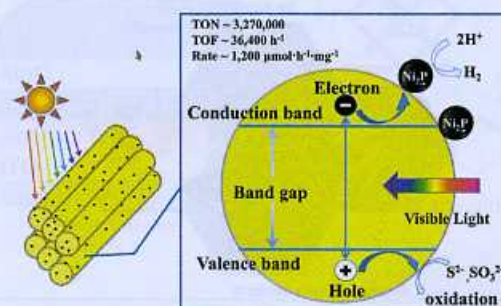
PAPERS

2668

Extraordinarily efficient photocatalytic hydrogen evolution in water using semiconductor nanorods integrated with crystalline Ni₂P cocatalysts

Zijun Sun, Huafei Zheng, Jingshi Li and Pingwu Du*

A hybrid structure constructed by uniformly anchoring crystalline Ni₂P cocatalyst on 1D CdS nanorods exhibits extraordinarily efficient photocatalytic activity for H₂ evolution in water (rate of 1,200 $\mu\text{mol h}^{-1} \text{mg}^{-1}$ and TOF of 36,400 h^{-1} per mol Ni₂P) under visible light irradiation.

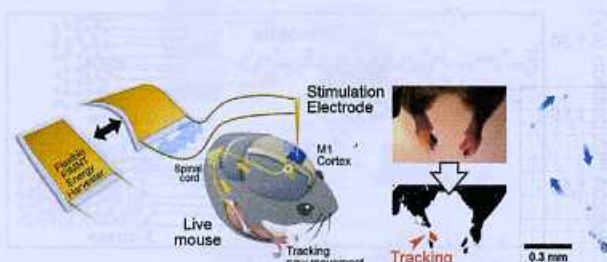


2677

Self-powered deep brain stimulation via a flexible PIMNT energy harvester

Geon-Tae Hwang, Youngsoo Kim, Jeong-Ho Lee, Sekwon Oh, Chang Kyu Jeong, Dae Yong Park, Jungho Ryu, HyukSang Kwon, Sang-Goo Lee, Boyoung Joung, Daesoo Kim* and Keon Jae Lee*

A self-powered deep brain stimulation has been demonstrated by a flexible piezoelectric PIMNT energy harvester to induce behavioural changes in a mouse.

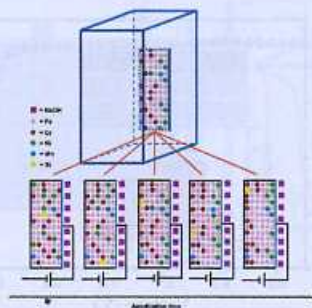


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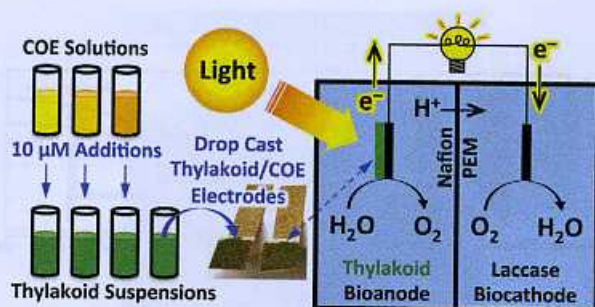
Stainless steel made to rust: a robust water-splitting catalyst with benchmark characteristics

Helmut Schäfer,* Shamaila Sadaf, Lorenz Walder, Karsten Kuepper, Stephan Dinkluge, Joachim Wollschläger, Lilli Schneider, Martin Steinhart, Jörg Hardege and Diemo Daum

Stainless steel was upon electro-initiated surface oxidation converted in an oxygen evolution reaction (OER) electrocatalyst with benchmark properties.



2698



The photobioelectrochemical activity of thylakoid bioanodes is increased via photocurrent generation and improved contacts by membrane-intercalating conjugated oligoelectrolytes

Nathan D. Kirchhofer, Michelle A. Rasmussen, Frederick W. Dahlquist, Shelley D. Minteer* and Guillermo C. Bazan*

Systematic modification of thylakoid bioanodes with conjugated oligoelectrolytes reveals the molecular structural features that enhance photobioelectrochemical devices.

2707

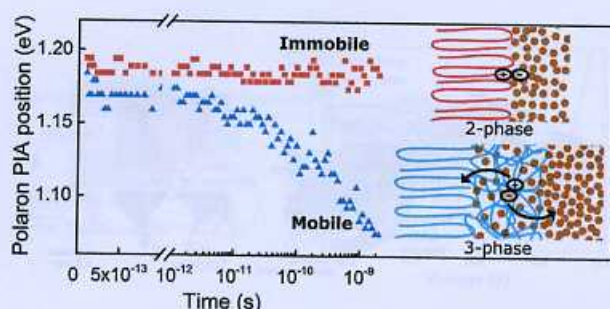


New ceramic electrodes allow reaching the target current density in bioelectrochemical systems

Diego Massazza, Rodrigo Parra, Juan P. Busalmen and Hernán E. Romeo*

New ceramic electrodes outweigh typical carbonaceous materials as anodes for microbial electrocatalysis.

2713

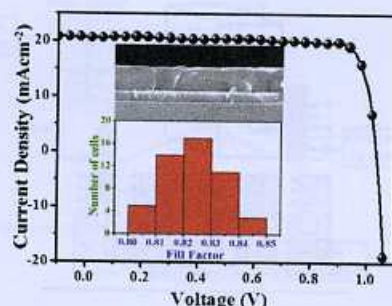


Spectroscopically tracking charge separation in polymer : fullerene blends with a three-phase morphology

Joseph K. Gallaher, Shyamal K. K. Prasad, Mohammad A. Uddin, Taehyo Kim, Jin Young Kim, Han Young Woo* and Justin M. Hodgkiss*

Transient absorption spectroscopy reveals that the superior performance of three-versus two-phase polymer : fullerene blends is associated with hole migration from intermixed to pure polymer phases.

2725



High efficiency stable inverted perovskite solar cells without current hysteresis

Chun-Guey Wu,* Chien-Hung Chiang, Zong-Liang Tseng, Md. K. Nazeeruddin*, Anders Hagfeldt* and Michael Grätzel*

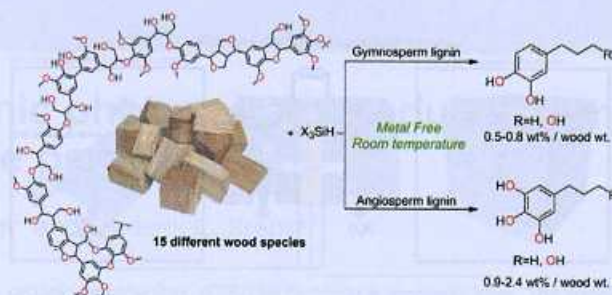
The inverted $\text{CH}_3\text{NH}_3\text{PbI}_3$ cell fabricated using a two-step method with H_2O as an additive in a PbI_2 solution exhibited an extremely high FF of 85%.

2734

Convergent reductive depolymerization of wood lignin to isolated phenol derivatives by metal-free catalytic hydrosilylation

Elias Feghali, Géraldine Carrot, Pierre Thuéry, Caroline Genre and Thibault Cantat*

Convergent reductive depolymerization of wood lignin to isolated phenol derivatives by metal-free catalytic hydrosilylation.

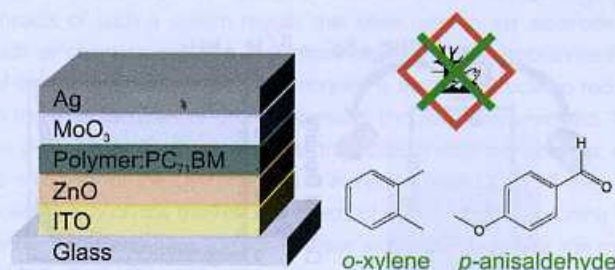


2744

Highly efficient polymer solar cells cast from non-halogenated xylene/anisaldehyde solution

Christian Sprau, Felix Buss, Michael Wagner, Dominik Landerer, Manuel Koppitz, Alexander Schulz, Daniel Bahro, Wilhelm Schabel, Philip Scharfer and Alexander Colmann*

Several high performance polymer:fullerene bulk-heterojunctions are deposited from non-halogenated xylene/anisaldehyde solution, yielding power conversion efficiencies up to 9.5%.

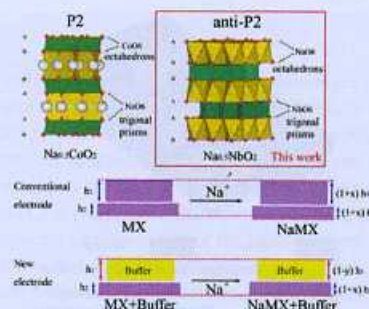


2753

Anti-P2 structured $\text{Na}_{0.5}\text{NbO}_2$ and its negative strain effect

Xuefeng Wang, Yurui Gao, Xi Shen, Yejing Li, Qingyu Kong, Sungsik Lee, Zhaoxiang Wang,* Richeng Yu, Yong-Sheng Hu and Liquan Chen

Layer-structured anti-P2 $\text{Na}_{0.5}\text{NbO}_2$ composed of NbO_6 trigonal prisms and NaO_6 octahedra shows a negative strain effect: its lattice shrinks upon Na-ion intercalation and expands upon deintercalation.

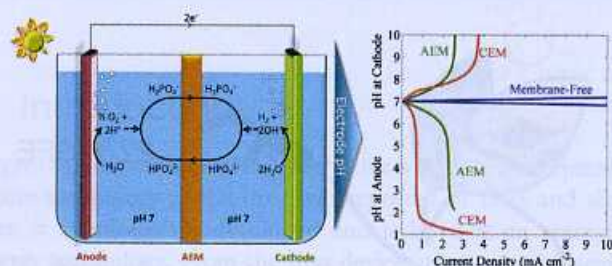


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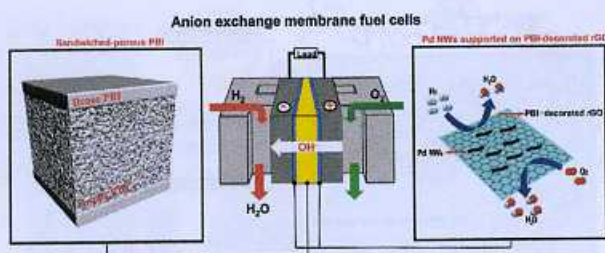
An electrochemical engineering assessment of the operational conditions and constraints for solar-driven water-splitting systems at near-neutral pH

Meenesh R. Singh, Kimberly Papadantonakis, Chengxiang Xiang* and Nathan S. Lewis*

Identified operating conditions and constraints for efficient operation of solar-driven water-splitting systems at near-neutral pH.



2768

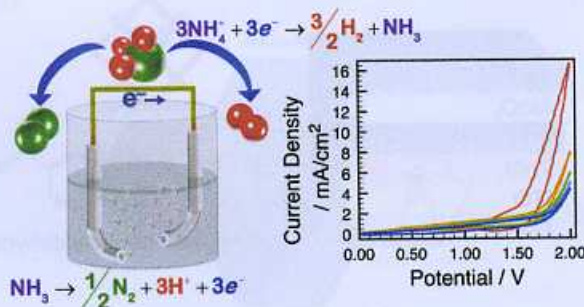


A high-performance sandwiched-porous polybenzimidazole membrane with enhanced alkaline retention for anion exchange membrane fuel cells

L. Zeng, T. S. Zhao,* L. An, G. Zhao and X. H. Yan

Polybenzimidazole (PBI)-based membrane electrode assemblies are fabricated with a sandwiched-porous PBI as the membrane and a new catalyst structure using PBI-decorated reduced graphene oxide as the supporting material for anion exchange membrane fuel cells.

2775



Electrolysis of liquid ammonia for hydrogen generation

Daniel J. Little, Milton R. Smith, III and Thomas W. Hamann*

The mechanism of splitting liquid ammonia is investigated to enable its use for renewable hydrogen storage.

2782

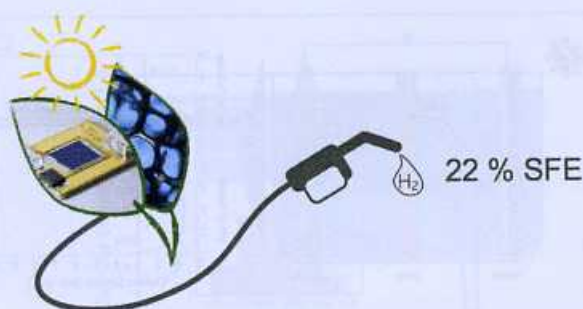


A novel solid-state Li–O₂ battery with an integrated electrolyte and cathode structure

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

A novel solid-state lithium–air battery allows a thin electrolyte layer to reduce R_{Ω} and a highly porous cathode (enhanced TPBs).

2791



Renewable fuels from concentrated solar power: towards practical artificial photosynthesis

Shannon A. Bonke, Mathias Wiechen,* Douglas R. MacFarlane and Leone Spiccia*

A solar-to-fuel conversion efficiency of 22% was achieved by using concentrated solar power to run a matched electrolyser based on Earth-abundant materials.