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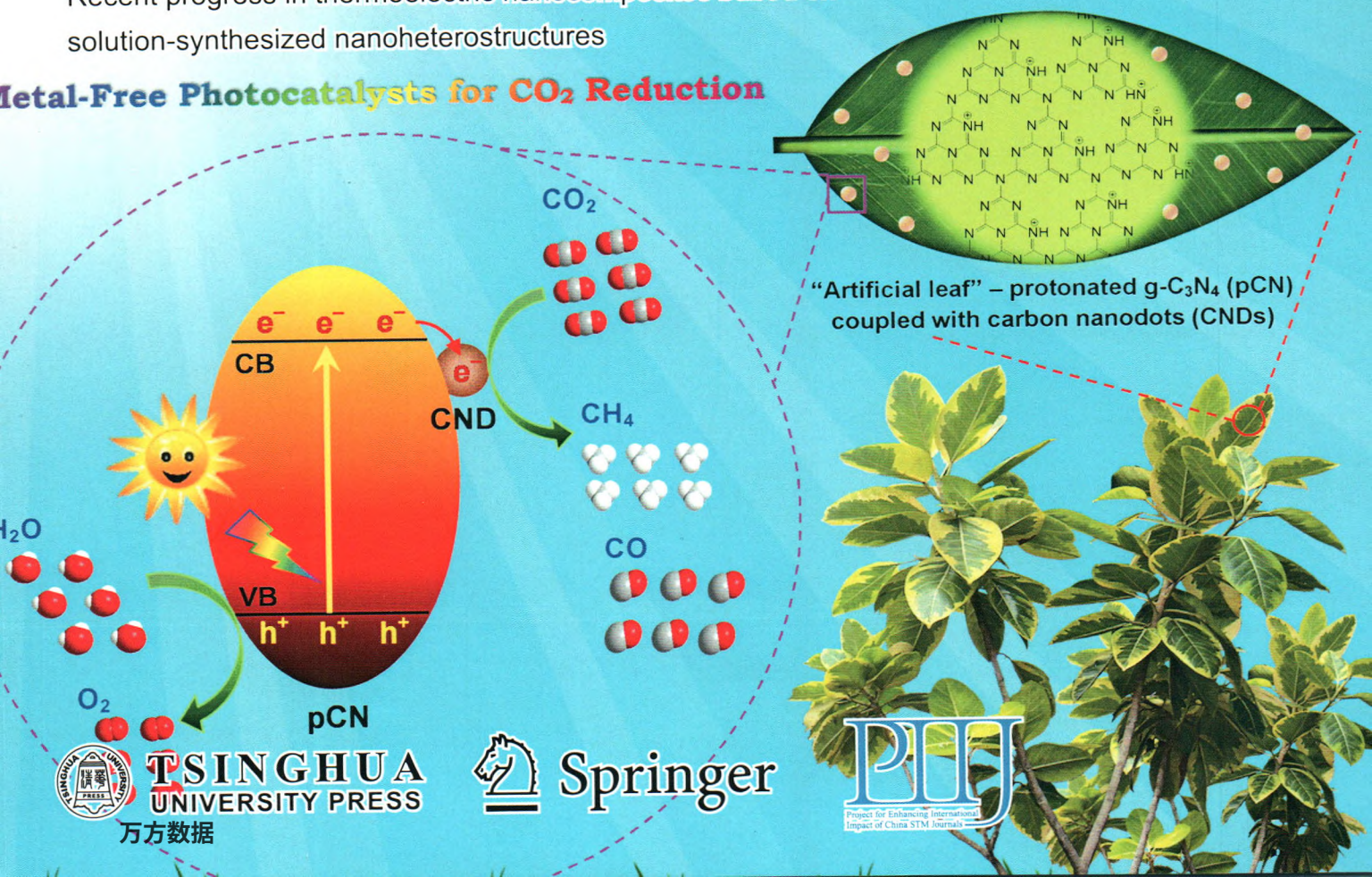
Congratulations to Professor Peidong Yang on winning the 2016 Nano Research Award

Transition metal–nitrogen–carbon nanostructured catalysts for the oxygen reduction reaction: From mechanistic insights to structural optimization

Tailoring interface of lead-halide perovskite solar cells

Recent progress in thermoelectric nanocomposites based on solution-synthesized nanoheterostructures



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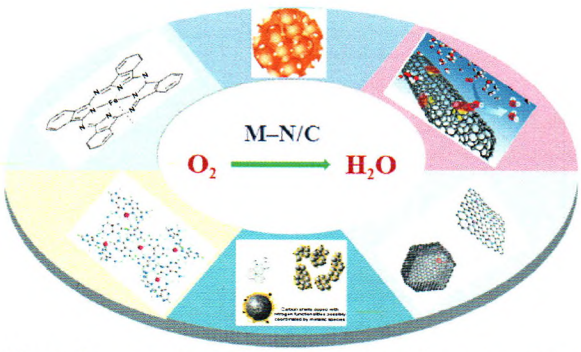
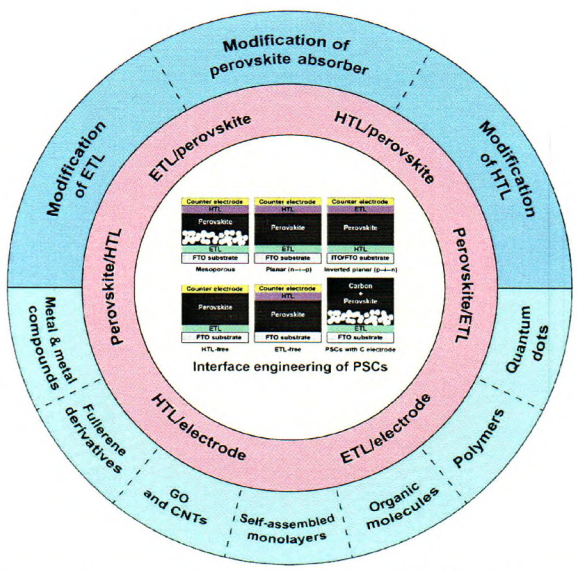


In this review, we demonstrate recent breakthroughs related to elucidating the nature of active sites using a variety of physicochemical methodologies and describe the substantial progress in engineering nanostructured metal–nitrogen–carbon (M–N/C, M = Fe, Co, etc.) catalysts by employing diverse precursors and synthetic strategies, which may offer some perspective for developing advanced electrocatalysts for the oxygen reduction reaction.



This review focuses on the interface tailoring of lead-halide perovskite solar cells, including the modification of each layer of the cell structure (i.e., perovskite absorber, electron-transport layers, and hole-transport layers) and the interfacial materials that can be introduced into the cell.

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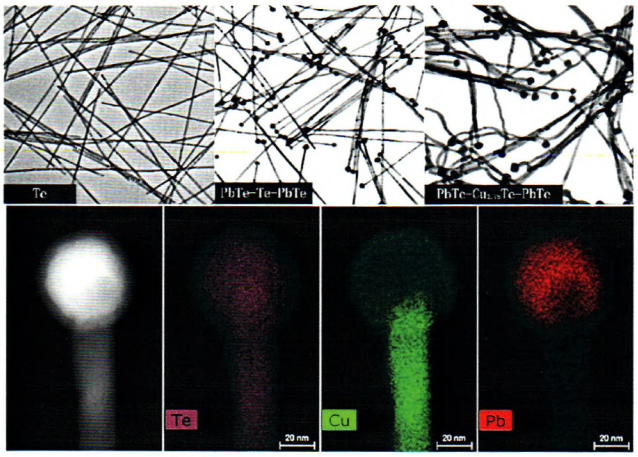
Recent progress in thermoelectric nanocomposites based on solution-synthesized nanoheterostructures

Wei Zheng[1], Biao Xu[1], Lin Zhou[1], Yilong Zhou[2], Haimei Zheng[2], Chenghan Sun[1], Enzheng Shi[1], Tanner Dale Fink[1], and Yue Wu[1,*]

[1] Iowa State University, USA
[2] Lawrence Berkeley National Laboratory, USA

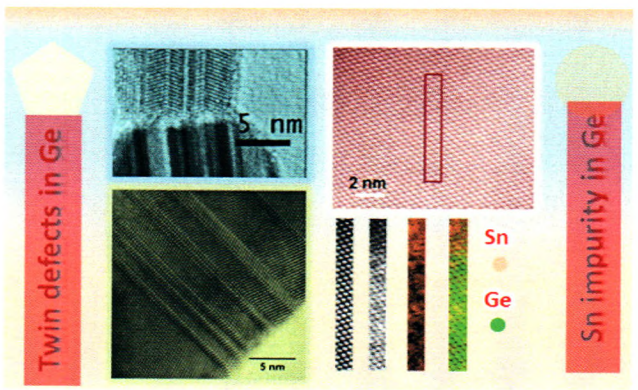


Recent progress in thermoelectric materials based on solution-synthesized nanoheterostructures is reviewed. We also present our latest effort in a phase-change-material ($Cu_{1.75}Te$)-incorporated thermoelectric nanocomposite.

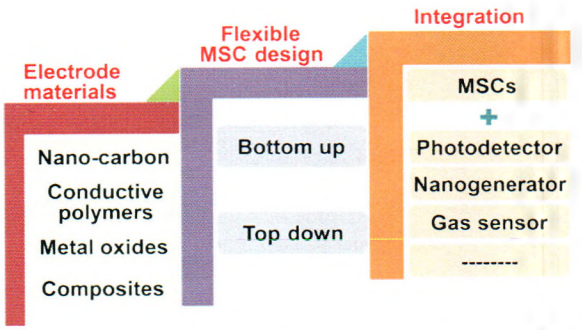
Inducing imperfections in germanium nanowires

Subhajit Biswas[1,2,*], Sven Barth[3], and Justin D. Holmes[1,2,*]

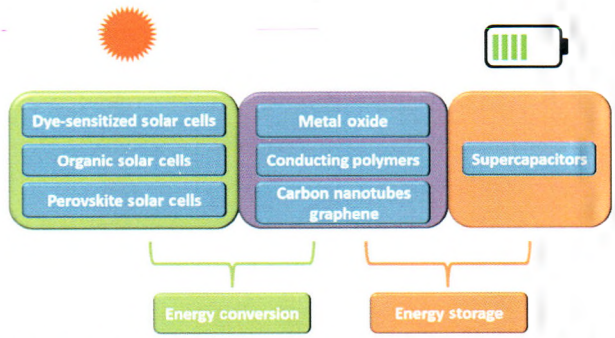
[1] University College Cork, Ireland
[2] Trinity College Dublin, Ireland
[3] Institute of Materials Chemistry, Austria



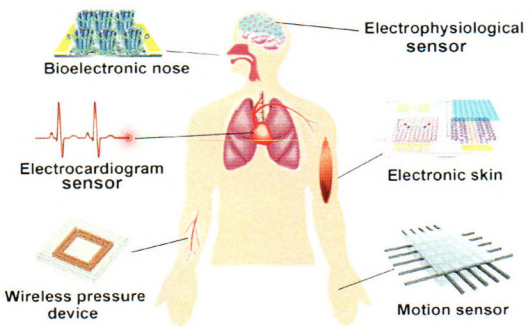
Three phase bottom-up growth is utilized to incorporate and engineer imperfections such as crystal defects and impurities in semiconductor Ge nanowires via catalyst and/or interfacial manipulation. High density of twin boundaries and above equilibrium amount of Sn in Ge enhance the functionality of the nanowires.



This review highlights the recent developments in the device design of flexible planar micro-supercapacitors (MSCs) and their integration with other electronic devices. The current challenges and future prospects for the development of flexible MSCs are also discussed.

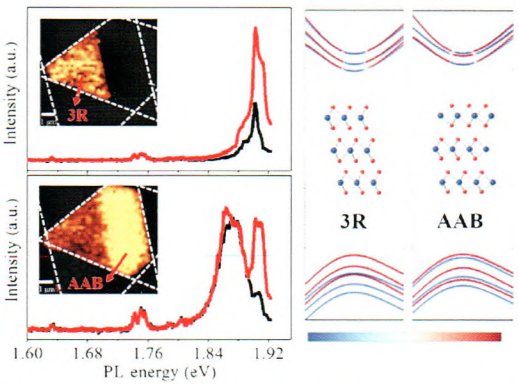


The integration of solar cells and energy-storage devices yields a promising self-powering system for simultaneously harvesting and storing energy from sunlight.

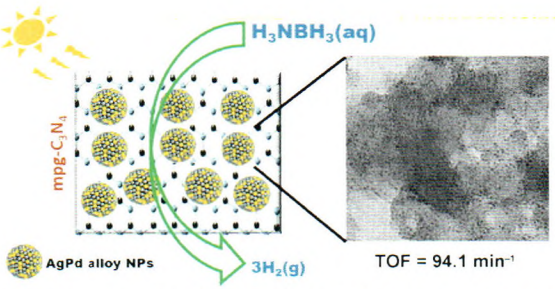


The recent progress of flexible and wearable biosensors based on nanomaterials is described. The challenges and opportunities for effective integration of multifunctional nanomaterials in bio-electronics are also proposed.

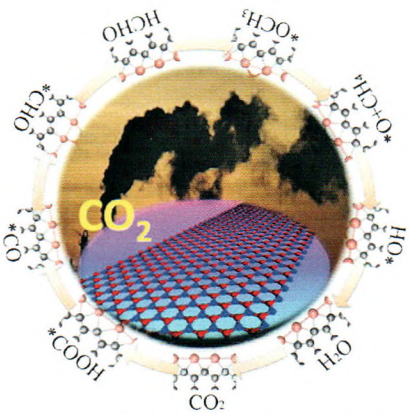
Research Articles



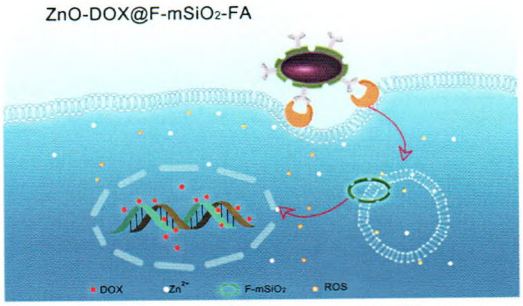
In addition to valley and layer pseudospins, stacking pseudospin generates distinct valley polarization behaviors in stacked trilayer MoS_2. Specifically, the AAB (ABB)-stacked samples exhibit two distinct photoluminescence (PL) peaks: One has strong valley polarization, and the other one is unpolarized.



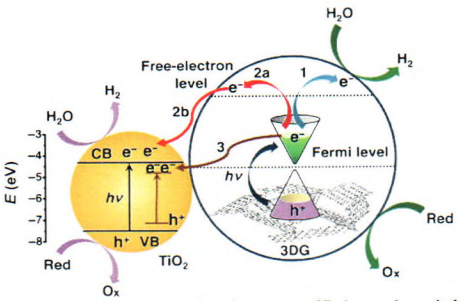
Herein, we report the first synthesis of mesoporous graphitic carbon nitride (mpg-C_3N_4)-assembled monodispersed AgPd alloy nanoparticles (mpg-C_3N_4@AgPd) and their unprecedented catalysis in the hydrolytic dehydrogenation of ammonia borane (AB) at room temperature. The activation energy and the total turnover frequency for the hydrolysis reaction were 28.2 $kJ \cdot mol^{-1}$ and 94.1 min^{-1}, respectively. These values are better than those for most heterogeneous catalyst systems tested for AB hydrolysis and are the best among all Pd-based catalysts.



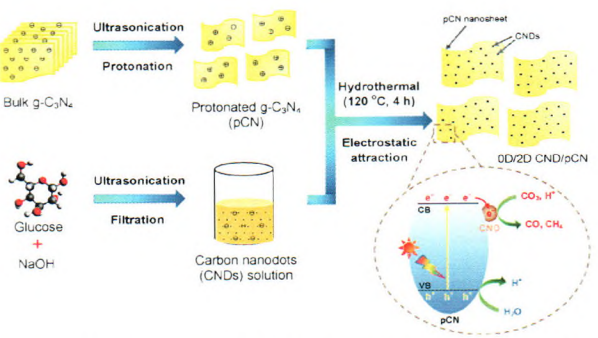
The Cu-terminated armchair GNRs with a width of $n = 3p + 2$ are more efficient catalysts for producing methanol from CO_2 with a free energy barrier of less than 0.5 eV, offering the advantages of a lower overpotential and higher selectivity than bulk Cu and other graphene-supported Cu structures.



A multifunctional pH-responsive mesoporous silica nanoreactor is presented. This well-designed nanoreactor avoids the non-specific degradation of ZnO nanoparticles, resulting in synergetic therapy by taking advantage of ZnO nanoparticle-induced oxidative stress and targeted drug release.



With a unique hot-electron mechanism, an efficient ultraviolet–visible (UV–vis) light driven hydrogen production from water splitting was demonstrated for the first time using a carbon-only bulk three-dimensionally cross-linked graphene (3DG) material as a robust catalyst. Combined with the widely used semiconductor TiO_2, a dramatically enhanced catalytic activity with a rate of 1,205 $\mu mol \cdot h^{-1} \cdot g_{cat}^{-1}$ under UV–vis light and a 7.2% apparent quantum efficiency at 350 nm is achieved for hydrogen production due to the synergetic effects between TiO_2 and such a bulk graphene material.

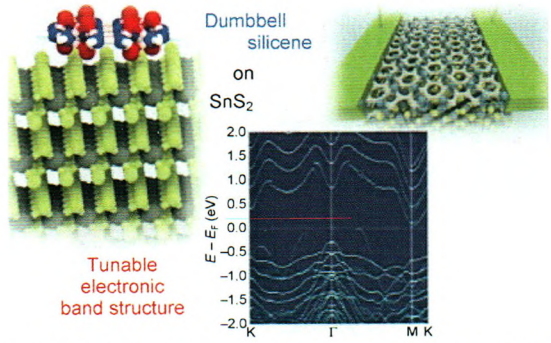


In this study, we successfully developed metal-free zero-dimensional/two-dimensional carbon nanodot (CND)-hybridized protonated g-C_3N_4 (pCN) (CND/pCN) heterojunction photocatalysts, synthesized via electrostatic attraction. The resulting enhancement of the photocatalytic reduction of CO_2 was attributed to efficient electron migration and separation from pCN to CNDs, because of the intimate interfacial coupling of CNDs and pCN. This hindered the charge recombination process, as determined by experimental results and computational simulations.

Predicting 2D silicon allotropes on SnS_2

Emilio Scalise[1,*] and Michel Houssa[2]

[1] Max-Planck-Institut für Eisenforschung GmbH, Germany
[2] University of Leuven, Belgium

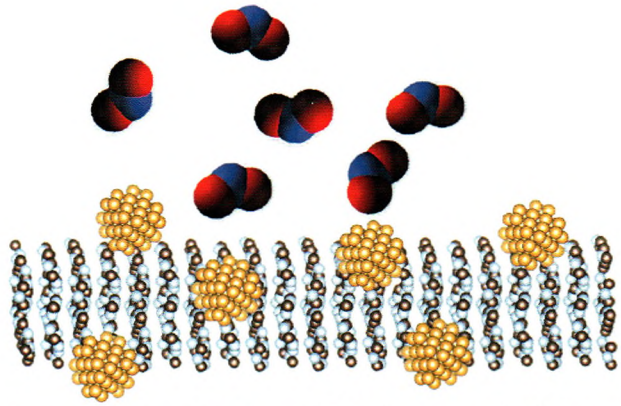


Dumbbell silicene is predicted to be stable on SnS_2, showing tunable electronic and optical properties. The results provide guidance on the growth of silicene on nonmetallic substrates, potentially boosting its potential for application in nanoelectronics.

Orientation controlled preparation of nanoporous carbon nitride fibers and related composite for gas sensing under ambient conditions

Suqin Li, Zhiwei Wang, Xiaoshan Wang, Fangfang Sun, Kai Gao, Ningxian Hao, Zhipeng Zhang, Zhongyuan Ma, Hai Li, Xiao Huang*, and Wei Huang*

Nanjing Tech University, China

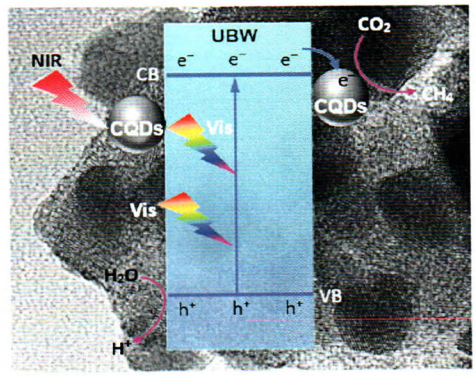


Highly oriented g-C_3N_4 fibers with both meso- and micro-pores were prepared and hybridized with Au nanoparticles for sensitive NO_2 detection under ambient conditions.

Harnessing Vis–NIR broad spectrum for photocatalytic CO_2 reduction over carbon quantum dots-decorated ultrathin Bi_2WO_6 nanosheets

Xin Ying Kong[1], Wen Liang Tan[1], Boon-Junn Ng[1], Siang-Piao Chai[1,*], and Abdul Rahman Mohamed[2]

[1] Monash University, Malaysia
[2] Universiti Sains Malaysia, Malaysia

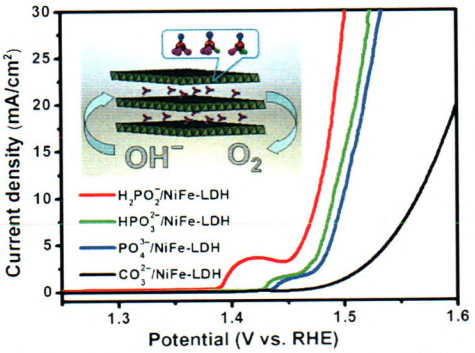


A carbon quantum dots (CQDs)/ultrathin Bi_2WO_6 nanosheets (UBW) hybrid nanocomposite was demonstrated to be a visible (Vis)–near-infrared (NIR)-responsive photocatalyst for CO_2 reduction to energy-rich CH_4 hydrocarbon fuel.

Phosphorus oxoanion-intercalated layered double hydroxides for high-performance oxygen evolution

Ma Luo[1], Zhao Cai[1,2], Cheng Wang[3], Yongmin Bi[1], Li Qian[1], Yongchao Hao[1], Li Li[1], Yun Kuang[1], Yaping Li[1], Xiaodong Lei[1], Ziyang Huo[4], Wen Liu[2,*], Hailiang Wang[2], Xiaoming Sun[1,*], and Xue Duan[1]

[1] Beijing University of Chemical Technology, China
[2] Yale University, USA
[3] Chinese Research Academy of Environmental Sciences, China
[4] Griffith University, Australia

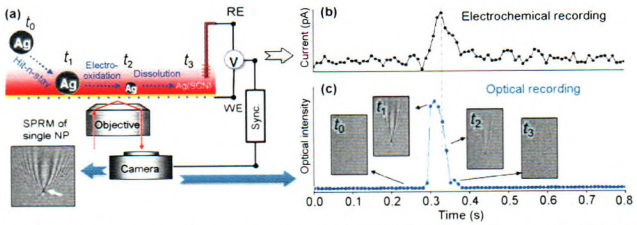


Nickel–iron layered double hydroxides with specific interlayer anions (namely, phosphate, phosphite, and hypophosphite) were fabricated by a co-precipitation method and investigated as oxygen evolution electrocatalysts. The interlayered anions modify the surface electronic structure of the Ni sites, resulting in high-performance for electrocatalytic oxygen evolution.

Simultaneous optical and electrochemical recording of single nanoparticle electrochemistry

Linlin Sun, Yimin Fang, Zhimin Li, Wei Wang*, and Hongyuan Chen*

Nanjing University, China

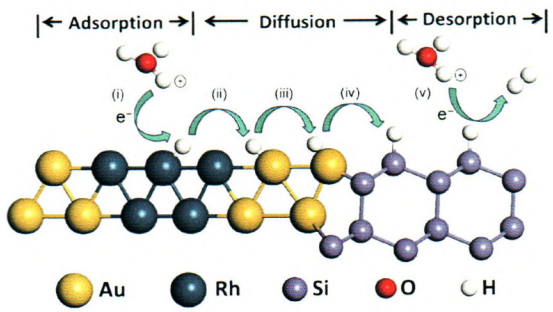


A simultaneous optical and electrochemical recording method was proposed to study dynamic electrochemical reactions during single nanoparticle collisions; this method enables an effective bottom-up strategy of elucidating the structure (optical signal)–activity (electrochemical signal) relationship at a single nanoparticle level.

A stepwise-designed Rh-Au-Si nanocomposite that surpasses Pt/C hydrogen evolution activity at high overpotentials

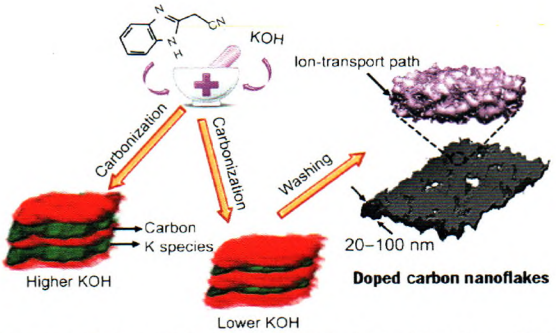
Binbin Jiang, Lulu Yang, Fan Liao, Minqi Sheng*, Haozhe Zhao, Haiping Lin*, and Mingwang Shao*

Soochow University, China

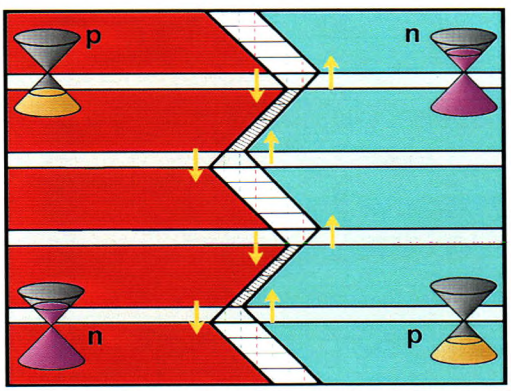


A stepwise design concept for highly efficient hydrogen evolving electrocatalysis is proposed based on a Rh-Au-Si nanocomposite and first principles calculations.

A graphene/polyurethane sponge with excellent chemical and physical stability prepared by *in situ* polymerization was used as an absorbing material for the continuous removal of oil from oil-spill water.



Carbon nanoflakes with an unparalleled combination of a large surface area, mesoporosity, and oxygen and nitrogen content are created through the single-step carbonization activation of (2-benzimidazolyl) acetonitrile. When used in supercapacitor electrodes, these carbons exhibit an excellent specific capacitance and a high rate capability in both basic and neutral aqueous electrolytes.

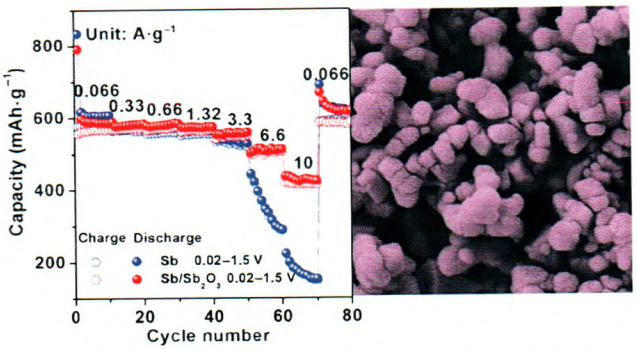


A topological p–n junction based on stacking defects in Bi_2Se_3 is proposed. The topological surface state doping is achieved using planar twin boundaries.

Simple synthesis of a porous Sb/Sb_2O_3 nanocomposite for a high-capacity anode material in Na-ion batteries

Jun Pan[1], Nana Wang[1,†], Yanli Zhou[1,‡], Xianfeng Yang[2], Wenyao Zhou[3], Yitai Qian[1,4,*], and Jian Yang[1,*]

[1] Shandong University, China
[2] South China University of Technology, China
[3] Jinan Licheng No.2 High School, China
[4] University of Science and Technology of China, China
† Present address: Taiyuan University of Technology, China
‡ Present address: Yantai University, China

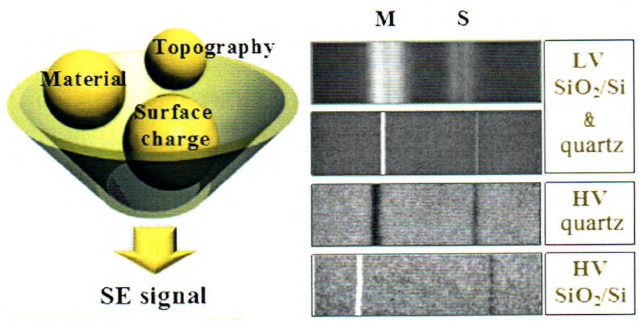


A porous Sb/Sb_2O_3 nanocomposite has been synthesized by the mild oxidation of highly aggregated Sb nanocrystals. A low charge voltage inhibits the formation of Sb_2O_3 and reduces the volume change upon cycling, improving the capacity at 10 $A \cdot g^{-1}$ to 412 $mAh \cdot g^{-1}$, which is ~71.6% of the capacity at 0.066 $A \cdot g^{-1}$.

Scanning electron microscopy imaging of single-walled carbon nanotubes on substrates

Dongqi Li[1], Jin Zhang[1], Yujun He[1,2], Yan Qin[3], Yang Wei[1,*], Peng Liu[1], Lina Zhang[1], Jiaping Wang[1,4], Qunqing Li[1,4], Shoushan Fan[1,4], and Kaili Jiang[1,4,*]

[1] Tsinghua University, China
[2] Sunwoda Electronic Co. Ltd., China
[3] Carl Zeiss Shanghai Co., Ltd. Beijing Office, China
[4] Collaborative Innovation Center of Quantum Matter, China

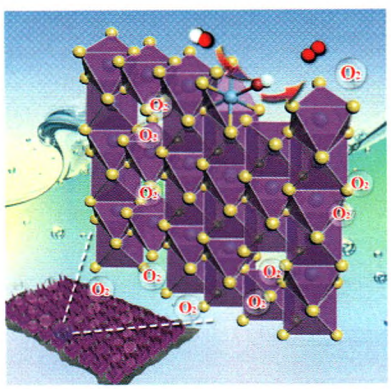


Scanning electron microscopy (SEM) images of single-walled carbon nanotubes (SWCNTs) on substrates are produced by the combination of signals from the topography, material, and surface charge. Modulating these factors yields m- and s-SWCNTs with various appearances.

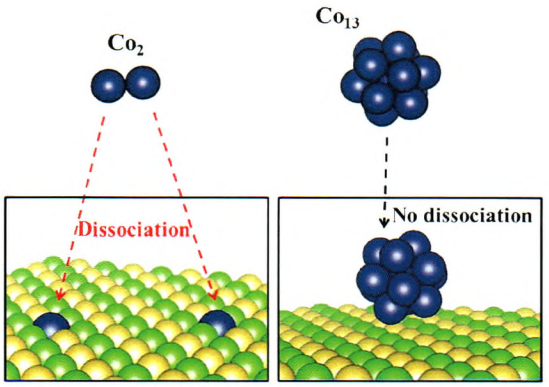
Co-vacancy-rich $Co_{1-x}S$ nanosheets anchored on rGO for high-efficiency oxygen evolution

Jiaqing Zhu[1], Zhiyu Ren[1,*], Shichao Du[1], Ying Xie[1], Jun Wu[1,2], Huiyuan Meng[1], Yuzhu Xue[1], and Honggang Fu[1,*]

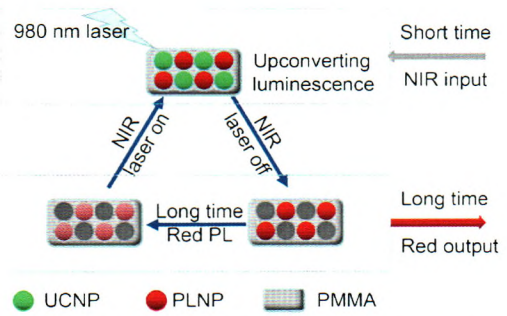
[1] Heilongjiang University, China
[2] Harbin Engineering University, China



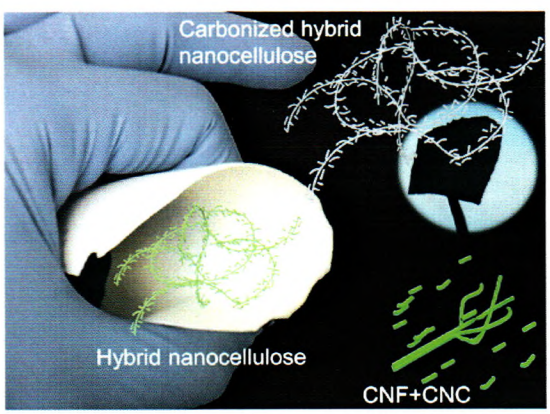
Co-vacancy-rich $Co_{1-x}S$ nanosheets were anchored on reduced graphene oxide (rGO) via a successive two-step hydrothermal reaction. The ultrathin nanosheets increased the quantity of cobalt vacancies (V'_{Co}) and exposed them on the surface. Experimental results and density functional theory calculations indicated that the V'_{Co} derived from the non-stoichiometric and sheet-like structure enhanced the oxygen evolution reaction activity of the $Co_{1-x}S$/rGO hybrid.



A deposited Co_2 cluster dissociates on ultrathin NaCl films grown on an Au(111) substrate, whereas a larger Co_{13} cluster does not fragment and remains stable atop the NaCl film.



Efficient upconverted persistent luminescence imaging is realized by combining the unique features of upconversion nanoparticles and persistent luminescence nanoparticles into polymethyl methacrylate.



The structural advantages of two types of nanocellulose were utilized to fabricate freestanding carbonized hybrid nanocellulose films with a specific surface area over 1,200 $m^2 \cdot g^{-1}$ as electrode materials for supercapacitors.

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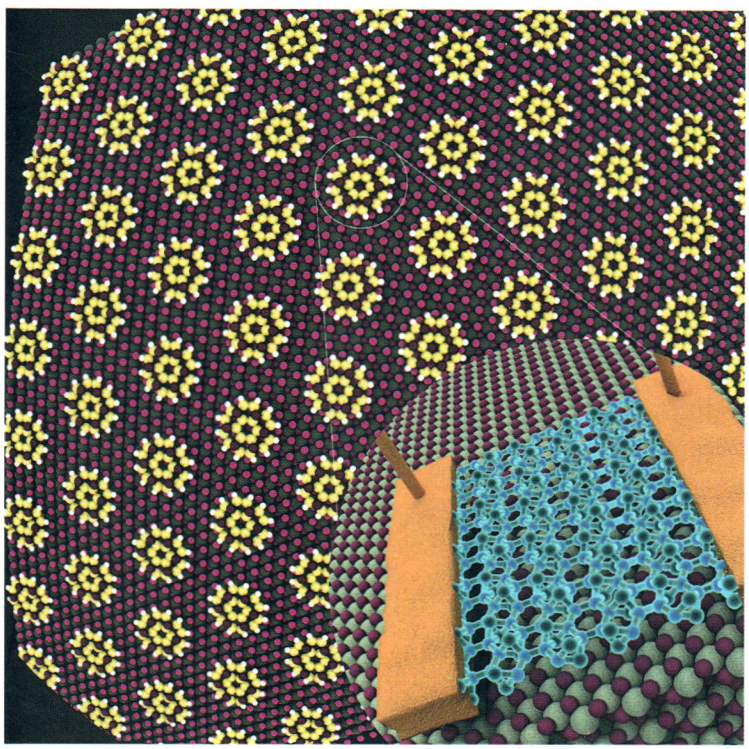

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