ENERGY FOCUS

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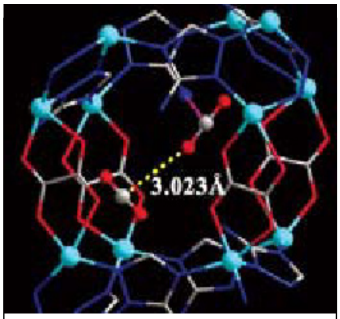
Details of CO_2-capture in amine-bearing MOFs revealed

Science DOI: 10.1126/science.1198066

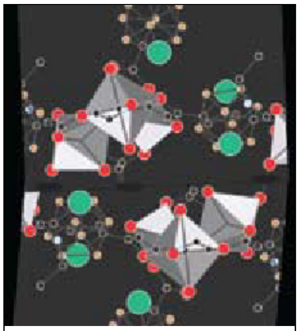
Carbon capture and sequestration is important to mitigate the effects of CO_2 release into the atmosphere from the burning of fossil fuels. Amine groups are well known to be excellent absorbers of CO_2. Amine functionalized metalorganic frameworks (MOFs) are considered to be some of the best candidates for capturing CO_2. A study has now revealed crystallographic details of the chemical interaction of carbon dioxide with amine functional groups in MOFs. Computations were in good agreement with experimental results. The results show that an appropriate combination of pore size, strongly interacting amine functional groups, and cooperative binding of CO_2 guest molecules results in large uptake of CO_2 in this material.



Metallacarboranes with Sc and Ti show effective hydrogen storage

Journal of the American Chemical Society DOI: 10.1021/ja104544s

Metallacarboranes could store hydrogen at or better than benchmarks set by the U.S. Department of Energy (DOE) Hydrogen Program for 2015, according to a new theoretical study. The transition metals scandium and titanium present in these metallacarboranes can contain an appreciable amount of hydrogen molecules. Calculations show that a matrix of metallacarboranes would theoretically hold up to 8.8% of its weight in hydrogen atoms. Scandium and titanium show the highest rate of adsorption and also demonstrate an affinity for "Kubas" interaction, a trading of electrons that can bind atoms to one another in certain circumstances, allowing for reversible hydrogen storage under ambient conditions. The carbon atoms in the metallacarboranes form metalorganic frameworks, allowing for hydrogen storage via Kubas interaction as well as van der Waals physisorption.



Abhishek Singh and Boris Yakobson, Rice University.

Multiple electron generation yields high-efficiency PVs

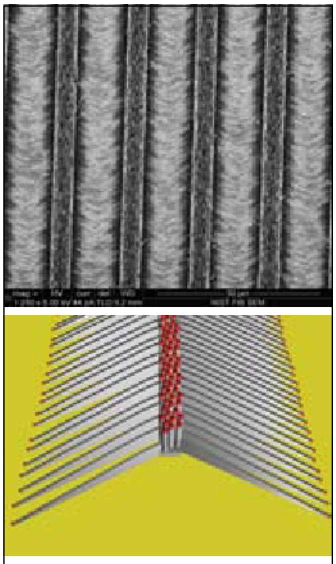
Science DOI: 10.1126/science.1191462

A new approach to super-efficient solar cells involves multiple exciton generation, freeing two electrons rather than one for each solar photon, potentially doubling the current generated. A research team has used a thin layer of lead sulphide quantum dots coated on a smooth titanium dioxide electrode to demonstrate collection of photocurrents with quantum yields greater than one electron per photon. This was demonstrated for photons in the blue end range of the spectrum. Researchers suggest that such a third-generation solar cell concept could potentially circumvent the so-called Shockley-Queisser limit of 31% efficiency.

Horizontal ZnO nanowires form nano-LEDs

ACS Nano DOI: 10.1021/nn1019972

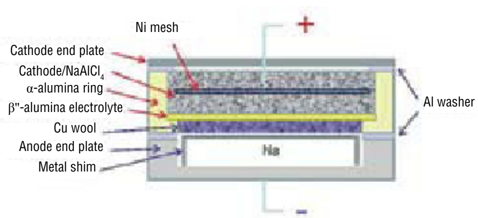
ZnO nanowires grown horizontally on a gallium nitride substrate were found to form nanoscale light-emitting interfaces or "nano-LEDs" as dubbed by the researchers. The fabrication technique used gold as the catalyst for nanowire growth. The gold was heated to 900°C, converting it into nanoparticles that served as growth sites and a medium for crystallization of zinc oxide molecules. Each zinc oxide nanocrystal grew horizontally by pushing the gold nanoparticle along the substrate surface to form a horizontal nanowire. When the thickness of the gold catalyst nanoparticle was approximately 20 nm, the nanowires grew a secondary structure, a shark-like dorsal fin or a nanowall, where the zinc oxide portion was electron-rich, and the gallium nitride portion was electron-poor. The interface between these two materials, which is a *p–n* heterojunction, allows electrons to flow across it when the nanowire-nanowall combination was charged with electricity. This movement of electrons produced light. These nano-LEDs could find use as light sources and detectors in photonic devices or lab-on-a-chip platforms.



Flat design of NaNiCl battery improves performance

ECS Transactions DOI:10.1149/1.3492326

A redesign of sodium-nickel chloride batteries promises to overcome some of the obstacles long associated with rechargeable batteries. Replacing their typical cylindrical shape with a flat disc design allows the battery to deliver 30% more power at lower temperatures. The battery's main components include abundant materials such as alumina, sodium chloride, and nickel; hence, they are less expensive to manufacture than lithium-ion batteries. Researchers found that a planar design allows for a thinner cathode and a larger surface area for a given cell volume. Since the ions can flow over a larger area with shorter pathways, they experience lower resistance. The battery's design also incorporates a thin layer of solid electrolyte, which also lowers the resistance. Because of the decrease in resistance, the battery can afford to be operated at a lower temperature while maintaining a power output 30% more than a similar-sized battery with a cylindrical design.



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New organic heterojunction equation describes voltage-current relation

Physical Review B DOI: 10.1103/PhysRevB.82.155305

A new equation describing the relationship between current and voltage at the junctions of organic semiconductors has been developed. Organic semiconductors present special challenges for researchers because they are more disordered than their inorganic counterparts. But they could enable advanced solar cells, thin and intense organic light-emitting diode displays, and high-efficiency lighting. The new equation developed is equivalent to the Shockley ideal diode equation developed for inorganic semiconductors. It will allow researchers to better describe and predict the properties of different organic semiconductors and help enable their wider adoption.

Biggest commercial order made for superconducting wire

Nature DOI:10.1038/news.2010.527

LS Cable, a South Korean company based near Seoul, has ordered three million meters of superconducting wire from U.S. firm American Superconductor based in Devens, Massachusetts. LS Cable will use the wire to make about 20 circuit kilometers of cable as part of a program to modernize the South Korean electricity network starting in the capitol Seoul. The superconducting wire is made of yttrium barium copper oxide (YBCO) that remains a superconductor up to 93 K (–180°C), meaning it can be cooled using liquid nitrogen. American Superconductor makes its wire using a core of YBCO coated with copper, stainless steel, or brass to provide strength. Yttria (Y_2O_3) nanodots dispersed through the YBCO layer stabilize the current flow, improving the current-carrying capability of the wire by helping control the magnetic fields in and around the wire.

White House goes solar

The Washington Post http://ht.ly/2OUqb

The Obama administration has decided to install solar panels and a solar hot water heater on the roof of the White House residence as part of a broader U.S. Department of Energy solar demonstration project, according to an announcement by U.S. Energy Secretary Steven Chu and White House Council on Environmental Quality chair Nancy Sutley. The solar panels for the residence will be chosen through a competitive process based on a range of selection criteria. Bids will be out soon to install 5–15 kW of solar panels on the White House. The system is expected to produce about 19,700 kW per year of power, more than twice the typical consumption of 8,800 kW in an average home in Washington D.C., according to U.S. government estimates. The installation is expected to be completed before the spring of 2011. □