THE DEPARTMENT OF ENERGY
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U.S. Department of Energy Projects Win 36 R&D 100 Awards for 2012

Technology Developments Aim to Advance American Energy, Environment and National Security

Washington D.C. – U.S. Department of Energy researchers have won 36 of the 100 awards given out this year by R&D Magazine for the most outstanding technology developments with promising commercial potential. The coveted awards – now in their 50th year – are presented annually in recognition of exceptional new products, processes, materials or software that were developed throughout the world and introduced into the market the previous year.

"Congratulations to this year's R&D 100 award winners," said Energy Secretary Steven Chu. "The research and development at the Department of Energy's laboratories continue to help the nation meet our energy challenges, strengthen our national security and improve our economic competitiveness."

The R&D 100 awards highlight some of the successes achieved by the Department's national laboratories in technology transfer, moving basic research results into commercial products.

Since 1962, when R&D Magazine's annual competition began, DOE national laboratories have been the recipient of over 800 R&D 100 awards in areas such as energy, national security and basic scientific applications.

R&D 100 awards are selected by an independent panel of judges based on the technical significance, uniqueness and usefulness of projects and technologies from across industry, government and academia. View the complete list of R&D 100 awards HERE.

A list of DOE's winning sites, technologies and corresponding press releases is below:

Argonne National Laboratory

- **Globus Online:** Designed by researchers at Argonne and the Computation Institute, Globus Online addresses a central problem in the emerging world of big data research: moving large quantities of information reliably, efficiently and securely among the data centers, scientific facilities, research laboratories, and supercomputing sites where data are produced, transformed, stored and consumed.
- **High-Energy Concentration-Gradient Cathode Material for Plug-in Hybrids and All-Electric Vehicles:** Argonne and several partners have developed a novel high-energy and high-power cathode material for use in lithium ion (Li-ion) batteries especially suited for plug-in hybrids and all-electric vehicles. It provides much higher energy and longer life than any other Li-ion cathode material, and as such is also ideal for batteries in hybrid vehicles and a wide range of consumer electronics applications.
- **Large Area Microchannel Plates (MCP):** MCP detectors are a critical technology for a wide variety of imaging and sensing applications ranging from medicine and physics to national security. The Argonne technology improves advanced imaging and sensing technologies by offering a means to fabricate larger area, higher performance and more robust MCP-based detectors at a significantly lower cost.
- **Ultra-fast and Large-Scale Boriding:** This green, efficient industrial-scale boriding process can drastically reduce costs, increase productivity, and improve the performance and reliability of machine components, such as engine tappets, agricultural knife guards, pump seals, and valves. This new process increases surface hardness of these components by factors of three to ten.

Read more about these projects at the lab: www.anl.gov

Brookhaven National Laboratory

- **Platinum Monolayer Electrocatalysts for Fuel Cell Cathodes:** Platinum is the most efficient electrocatalyst for fuel cells, but platinum-based catalysts are expensive, unstable, and have low durability. The new electrocatalysts have high activity, stability, and durability, while containing only about one-tenth the platinum of conventional catalysts used in fuel cells, significantly reducing overall costs.

Read more about this project at the lab: http://www.bnl.gov

Idaho National Laboratory

- **Wireless Spectrum Communications (WSComm**): is an innovative wireless technology platform that offers the potential of expanding the use of the available radio frequency spectrum, which delivers mobile phone and other services. WSComm uniquely implements a special data transfer method called filter bank multicarrier spread spectrum, which transmits the same information across a number of sub-bands and excludes interference.

Read more about this project at www.inl.gov

Lawrence Berkeley National Laboratory

- **Compact Variable Collimator (CVC):** The CVC allows researchers to quickly and accurately adjust X-ray beams for X-ray microscopy, protein crystallography and small angle X-ray scattering to optimize resolution. This allows researchers to extract the highest quality data from less-than-perfect protein crystals rather than discard crystals with defects and spend time and money preparing new ones. The CVC has already been used at the lab's Advanced Light Source to make critical discoveries in areas that include Alzheimer's and Parkinson's disease, Lassa fever, antibiotic resistance and food crop improvements.
- **Laser Ablation Molecular Isotopic Spectrometry (LAMIS):** LAMIS offers a green chemistry alternative to existing mass spectrometry techniques that is faster, less expensive and can be carried out from across vast distances. It entails focusing the energy of a high-powered laser beam to a tiny spot on the surface of a sample to create a plasma plume for analysis. The LAMIS technology could loom large in the future of homeland security and planetary space exploration.
- **Multinozzle Emitter Array (MEA):** The MEA has been called a "game changer" in the use of mass spectrometry to analyze biomolecules in microfluidic chips because it enables researchers to perform global analysis of nucleic acids, proteins and metabolites from a single cell. The MEA provides a threefold boost in sensitivity over previous technologies.
- **High Output Neutron Generator, co-developed with Adelphi Technology Inc.:** Powered by a magnetron of the type used in microwave ovens and incorporating a unique plasma ion source the generator produces its beams off the fusion reaction between deuterium ions rather than the radioactive tritium used in reactors. This makes the generator safe and economic to use over long periods of time. Applications include neutron activation studies, detection of explosives and nuclear materials, neutron radiography, and chemical analysis.

Read more about these projects at the lab: http://www.lbl.gov/

Lawrence Livermore National Laboratory

- **High Velocity Laser Accelerated Deposition (HVLAD):** a new photonic method for producing protective coatings with ultra high-strength, explosively bonded interfaces. These coatings prevent corrosion, wear and other modes of degradation in extreme environments. In addition to being crucial to future fusion reactors, HVLAD materials and coatings have other important uses include bearing and shafts for wind

turbines, corrosion-resistant structures of offshore platforms, better pipelines for oil and gas transmission, and ultra-hard corrosion-resistant surfaces for naval ships.

- **Laser Energy Optimization by Precision Adjustments to the Radiant Distribution (LEOPARD):** The world's most energetic lasers greatly benefit from operating at the maximum energy that can be safely extracted from their laser amplifiers. To enhance the operability of these laser facilities, as well as meet the requirements of future laser-driven fusion power plants now under conceptual design LEOPARD was developed. The LEOPARD system may also find use in laser-based machining, surgery, lithography, and defense applications.
- **Plastic Scintillators for neutron and gamma discrimination:** Detecting neutrons and gamma rays, and distinguishing one from the other, are key to identifying nuclear substances such as uranium and plutonium and differentiating them from benign radioactive sources. A team of LLNL researchers developed the first plastic material capable of efficiently doing so. Plastic scintillators can offer the same or even better resolution compared to standard commercial liquid scintillators, but without the associated hazards of liquids. With the material's low cost, detectors with huge plastic sheets could aid in the protection of ports, stadiums and other large facilities.
- **Snowflake Power Divertor, developed with Princeton Plasma Physics Laboratory and the Center for Research in Plasma Physics:** A major scientific and technological hurdle for fusion energy is to devise a technique so that materials can withstand the huge flux of heat that emanates from the reactor core. The snowflake divertor, which was demonstrated in two experimental fusion facilities, including the National Spherical Torus Experiment, offers the potential to solve this problem, or at least reduce the heat flux by such an extent that the remaining materials challenge is tractable.
- **Multiplexed Photonic Doppler Velocimeter (MPDV), co-developed by National Security Technologies LLC.: The MPDC is** a portable optical velocimetry system that simultaneously measures up to 32 discrete surface velocities onto a single digitizer by multiplexing signals in frequency and time. MPDV has been used at the Laboratory's National Ignition Facility and has allowed scientists at Los Alamos National Laboratory and the Nevada Test Site to gather velocimetry data on key national security work at unprecedented density and comprehensiveness.

Read more about these projects at the lab: https://www.llnl.gov/

Los Alamos National Laboratory

- **Sequedex:** is a revolutionary software package to speed read DNA using keyword recognition technology and evolutionary theory. A human genome's worth of DNA analysis can be done in 30 minutes on a single core of a laptop computer and the DNA of a community of microorganisms can be analyzed in an afternoon.
- **U-TURN, Turning Uranium Around:** this cost-effective, environmentally green, and safe method to produce two new uranium iodide reagents will not only provide a nondestructive path forward for more than 5,300 metric tons of stockpiled nuclear waste but also stands to revolutionize the use of depleted uranium in chemistry, catalysis, materials science and energy.
- **Valveless Laser Processing, co-developed with the Y-12 National Security Complex:** this technology eliminates the use of valves in hermetically sealed containers by using a laser to repeatedly access and reseal the containers. Applications range from advancing the safety of sampling high-hazard waste containers to improving leak testing of pacemakers before use.

Read more about these projects at the lab: www.lanl.gov

National Energy Technology Laboratory

- **BIAS Process for Carbon Dioxide (CO_2) Capture:** This process involves low-cost, regenerable amine-based sorbents that offer advantages over existing technologies, including increased CO_2 capture capacity, reduced corrosion, lower energy requirements and costs, and minimized water usage. The process can be used as a retrofit to older coal-fired power plants or applied to new, more efficient pulverized coal-fired power plants.

Read more about this project at the lab: http://www.netl.doe.gov/

National Renewable Energy Laboratory

- **Desiccant-Enhanced Evaporative Air-Conditioning (DEVAP):** developed with AIL Research and Synapse Product Development LLC: DEVAP systems cool commercial buildings at a small fraction of the energy use of a traditional cooler, provides superior comfort in any climate, releases far less carbon dioxide, and could cut costly peak electricity demand by 80 percent.
- **SJ3 Solar Cell:** co-developed with Solar Junction, the cell achieves a world-record conversion efficiency of 43.5% with potential to reach 50 percent. Like a three-blade safety razor that uses all its blades for a closer shave, the three-layered SJ3 cell captures different light frequencies, ensuring the best conversion of photons to electrons. The 43.5% efficiency occurs under lens-focused light having 418 times the intensity of the sun.

Read more about this project at the laboratory: http://www.nrel.gov/.

Oak Ridge National Laboratory

- **Broadband Micromechanical Antenna:** This small electronic device can replace traditional long metal antennas. It represents a potentially revolutionary system that uses nanomechanical oscillators to detect very small electric fields over large frequency ranges while maintaining substantial power efficiency. The technology can affect magnetic field sensing, remote sensing applications, lightning detection and underground and underwater telecommunication.
- **HiCap Absorbents, co-developed by Hills Inc.:** HiCap Aborbents use low-cost reusable materials to selectively remove metals from aqueous environments. HiCap's uptake of uranium is nearly seven times more than that of any similar product. The selective chemical attachment capacity of heavy metals by HiCap can be used for nuclear energy and environmental applications.
- **Highest Pinning Force, High-Temperature Superconducting Wires with Double-Perovskite, Tantalate, Nano-Pinning Centers, co-developed by SuperPower Inc. and the University of Houston:** This technology allows high-temperature superconducting wires to carry more current in high, applied magnetic fields. This is accomplished by incorporating controlled nanostructures of a new phase within the superconducting wire.
- **Low-cost, lightweight robotic hand based on additive manufacturing:** This technology costs approximately 10 times less than similar devices while commanding 10 times more power than other electric systems. Composed of only 46 parts, this simplified, lightweight robotic hand can be manufactured and assembled within 40 hours. It has robotics, prosthetics, remote handling and biomedical and surgical applications.
- **NanoSHIELD Coatings (Nano – Super Hard – InExpensive - Laser Deposited Coatings):** NanoSHIELD is a protective coating that can extend the life of costly cutting and manufacturing tools by more than 20 percent, potentially saving millions of dollars over the course of a project. It is created by laser fusing a unique iron-based powder to any type of steel, which forms a strong metallurgical bond that provides wear resistance between two and 10 times greater than conventional coatings. NanoSHIELD was designed to protect high-wear tools used for tunnel boring and construction, but its potential for Navy applications and geothermal drilling tools also is being explored.

- **Radio Channel Simulator (RCSim), co-developed by Networcsim LLC.:** This software provides the information needed to offer wireless networks to challenging areas such as factory floors, underground mines and offshore drilling platforms. RCSim predicts radio signal strength with greater accuracy than competitors throughout geometrically complex environments such as industrial facilities and dense urban areas.
- **Wavelength-shifting scintillator neutron detector, co-developed by PartTec Ltd.:** The WLS detector is a breakthrough technology for replacing large area helium-3 detectors at neutron scattering facilities throughout the world. The WLS detector uses lithium-6 instead of helium-3 gas to detect neutron radiation. This replacement technology is critical because there is a long-term shortage of helium-3 gas. Neutron detectors are used in medical physics, nondestructive testing, advanced neutron imaging science, environmental monitoring and for homeland security.
- **Asymmetric Rolling Mill, co-developed with FATA Hunter Inc.:** The Asymmetric Rolling Mill provides a way to efficiently process sheet and plate materials, accelerating the production and availability of low-cost magnesium a lightweight metal. Commercial use of magnesium has been limited because of the high cost associated with its multistep production process. This technology is likely to reduce processing steps, thereby reducing the cost of finished magnesium components and allowing for the replacement of aluminum with magnesium in many commercial goods. The widespread use of magnesium instead of aluminum in cars would reduce vehicle weight and lead to improvements in transportation by improving fuel economy.

- **Low Frequency RF Plasma Source (LFRF-501)**, **co-developed with Structured Materials Industries, Inc.**: LFRF-501 is a low-cost plasma generator for research, development and production of nanometer scale materials at lower temperatures, faster rates and with enhanced properties. These materials are enabling new developments in many technologies, including microelectronics, renewable energy, sensors and LEDs.

Read more about these projects at the lab: http://ornl.gov/

Pacific Northwest National Laboratory

- **Graphene Nanostructures for Lithium Batteries, co-developed with Vorbeck Materials Corp. of Jessup Md. and Princeton University:** Small quantities of graphene – ultra-thin sheets of carbon atoms – can dramatically improve the performance and power of lithium-ion batteries. • Graphene Nanostructures could lead to the development of batteries that last longer and recharge quickly, drastically reducing the time it takes to charge a smartphone to as little as ten minutes and charging an electric vehicle in just a few hours.
- **Advanced Carbon Dioxide Removal Unit, co-developed with Steward Advanced Materials:**

As early as 2014, U.S. Navy submarines may be fitted with a versatile air purification system which employs a novel granular sorbent material called that captures carbon dioxide directly from the atmosphere, while providing a more environmentally friendly removal process. The system replaces a bulky, heavy and corrosive liquid process that has been used for more than half a century.
Read more about these project at the lab: http://www.pnl.gov/

Sandia National Laboratories

- **Neutristor:** This ultra-compact neutron generator is a thousand times smaller than anything on the market today. The computer chip shaped-neutron source can be adapted to medical and industrial applications.

- **The Sandia Cooler**: Also known as the "Air Bearing Heat Exchanger," this technology will significantly reduce the energy needed to cool the processor chips in data centers and large-scale computing environments. The Sandia Cooler also offers benefits in other applications where thermal management and energy efficiency are important, particularly heating, ventilation and air-conditioning (HVAC).
- **Microsystems Enabled Photovoltaics (MEPV)**: Tiny, glitter-sized PV cells are created using microdesign and microfabrication techniques, released into a solution and "printed" onto a low-cost substrate. The technology has potential applications in buildings, houses, clothing, portable electronics, vehicles and other contoured structures.
- **Digital Microfluidic Hub**: This technology is a droplet-handling router that automates complex, microliter-scale molecular biology sample-preparation. The technology can help rapidly identify and characterize unknown pathogens.

Read more about these projects at the lab: http://sandia.gov/

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