Sandia wins four R&D 100 awards in wide-ranging display of expertise

By Neal Singer

Sandia researchers — competing in an international pool that includes universities, start ups, large corporations, and government labs — received four R&D 100 Awards this year, and played a role in at least one more.

R&D Magazine presents the awards each year to researchers whom its magazine editors and independent judging panels determine have developed the year's 100 most outstanding advances in applied technologies.

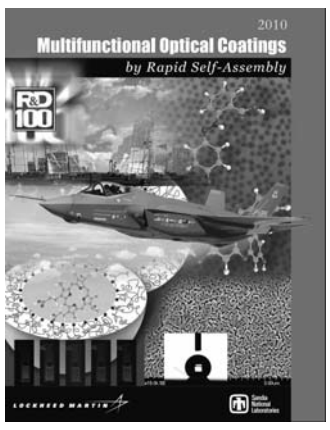
The awards, with their focus on practical effects rather than pure research, reward entrants on their products' design, development, testing, and production.

Winners are expected to participate in a formal awards banquet at the Renaissance Orlando Hotel in Florida on Nov. 11.

DOE Secretary Steven Chu said, "The large number of winners from the Department of Energy's national labs every year is a clear sign that our labs are doing some of the most innovative research in the world. This work benefits us all by enhancing America's competitiveness, ensuring our security, providing new energy solutions, and expanding the frontiers of our knowledge. Our national labs are truly national treasures, and it is wonderful to see their work recognized once again."

The four Sandia award winners are:

1. "**Multifunctional Optical Coatings by Rapid Self-Assembly.**" The technique inexpensively forms film-like coatings already widely used in consumer electronics, semiconductor devices, and high-performance glass and ceramics. Rather than requiring high temperatures and/or the considerable vacuum of current commercial operations, the Sandia method disperses commercially available polymers by inserting them in common solvents under ambient conditions and then uses simple spin, dip, or spray techniques to coat surfaces. Evaporation of the solvents induces the polymers to self-assemble into multifunctional nanoparticles as well as films with tailored optical properties and a nanostructured surface. Because the process is compatible with conventional spray processing, it can be applied directly to the coating of large or complex parts, which current commercial methods are less able to do. The work was led by Sandian Hongyou Fan (1815) and his group as a joint entry with Lockheed Martin. Researchers from University of New Mexico also participated.



Sandia: Hongyou Fan (PI, 1815); Huimeng Wu (postdoc, 1815); UNM: Zaicheng Sun, Feng Bai; Davidson College: Dan Boye (sabbatical professor in Hongyou Fan's group); Lockheed Martin: Earl Stromberg (Lockheed Martin, Aeronautics Company)

2. "**Acoustic Wave Biosensor for Rapid Point-of-Care Medical Diagnosis.**" The device, a joint effort of Sandia and the University of New Mexico Health Sciences Center, is essentially a handheld, battery-powered, portable detection system capable of identifying a wide range of medically relevant pathogens from their biomolecular signatures. Detection can occur within minutes, not hours, at the point of care, whether that care is in a physician's office, a hospital bed, or at the scene of a biodefense or biomedical emergency. According to the researchers, "The Acoustic Wave Biosensor provides fast, low-cost diagnostic results with as good or better sensitivity than traditional techniques." The device's sensor array works like a miniature analytical balance, weighing the amount of pathogen that binds to its surfaces. The pathogen-bound sensor acts like a spring with a small weight bouncing at one end. As more pathogens stick to the surface, the weight on the spring increases, causing the spring's bouncing speed to decrease by a measurable amount. The sensors detect minute weight differences by this method. A variety of sticky substances (ligands) attach to different pathogens. Surface tension draws the sample over the sensor, so no pumps or valves are required. This makes the sensors smaller, more reliable, and less expensive to manufacture, and extends the operating time of the rechargeable batteries. System control, data analysis, and reporting are performed by a personal digital assistant.

Sandia: Susan Brozik, Darren Branch, Thayne Edwards, and David Wheeler (all 1714); UNM: Richard Larson, Brian Hjelle, David Brown, Pam Hall, and Marco Bisoffi

3. "**CANARY: Event Detection Software.**" How does a country whose water supply is as dispersed as that of the US act to rapidly and accurately detect contamination of any of it, whether due to natural causes or terrorist activities? Sandia researchers, led by Sean McKenna (6731), working with the US Environmental Protection Agency's National Homeland Security Research Center, have developed software that enables immediate contaminant detection by continuously analyzing signals from networked sensors for unusual responses. The software is designed to be compatible with sensor technologies and information technology programs existing at most water utilities, and it can be easily modified by the end-user for specific applications and for utility-specific customization. But this isn't just a war-and-disease prevention program — several utilities have reported that using the software has enhanced the day-to-day water quality management within their distribution networks. Sean says, "I think this project has been a great example of staff with different backgrounds and expertise coming together from across the Lab (three divisions and four centers) to solve a security problem that is making an impact both nationally and internationally. For example, Singapore has been running CANARY on its national drinking water system since July of 2009."

From Sandia: Sean McKenna (6731); David Hart (6731); Katherine (Kate) Klise (6731); Eric Vugrin (6371); Mark Koch (5433); Shawn Martin (1415); Bill Hart (1415); US EPA National Homeland Security Research Center: Regan Murray, Terra Haxton, John Hall; EPA Office of Water: Katie Umberg

4. "**Micro Power Source.**" You've accepted that batteries run out of power and that newer batteries are rechargeable in wall electric sockets. But why should you go through all that? Why not a battery covered by a thin photovoltaic film? Just like on rooftops, the photovoltaic surface could harvest sunlight and turn it into electricity, recharging the battery in an ongoing process. This work, a joint effort with Pacific Northwest National Laboratory and Front Edge Technology Inc. in Baldwin Park, Calif., was originally part of a Defense Advanced Research Projects Agency program, but commercial applications were "evident from the start," the researchers wrote. The most likely immediate applications of the durable batteries are self-powered environmental sensors, self-powered tags for material tracking, and self-powered "smart" cards to enhance user features and security. The key feature for the micropower source is a volume of only one microliter, yet a high peak-power density greater than 1,000 watts per liter. This makes the device useful for powering wireless microsystems that sense, record, transmit, and/or actuate. The photovoltaic battery stack itself is only five millimeters in diameter and approximately 50 micrometers thick. (A human hair is approximately 70 micrometers thick.)

Sandia team includes Todd Bauer (1746); David Stein (1726); Carlos Sanchez (1746); Rob Jarecki (1746); Randy Shul (1746); Darlene Udoni (1726); Doug Greth (LMATA); and Chris Ford (LMATA); with assistance from the MESAFab staff. LMATA Government Services, a small business joint venture created by L&M Technologies, Inc., and ATA Services, Inc., is dedicated to the recruitment and staffing of professional, support, and administrative personnel.

5. Another Sandia effort aided researchers at Los Alamos National Laboratories in developing another winning effort: "The Solution Deposition Planarization."