Exceptional service in the national interest

Sandia National Laboratories

Microsystems Science, Technology & Components

R&D 100 Award-Winning Technologies

Each year, R&D Magazine honors the top 100 technology products that exemplify significant, innovative research and development advances. Researchers from Sandia National Laboratories compete internationally for these honors as hundreds of technologies are nominated from universities, private corporations, and other government laboratories.

2013 R&D 100 AWARD WINNER

MEMBRANE PROJECTION LITHOGRAPHY

This fabrication technique enables the creation of a diverse array of microscopic 3D structures with macroscopic impact. For instance, the technique can be used to create 3-dimensional integrated circuits, the next step in the evolution of 2-dimensional microprocessors. It is also capable of creating structured electromagnetic materials. Currently, the technique is being used to make thermal antennas which can control the direction of heat emitted from an object, potentially easing cooling and heating needs for satellites or perhaps even buildings and cars.

2012 R&D 100 AWARD WINNER

MICROSYSTEMS ENABLED PHOTOVOLTAICS

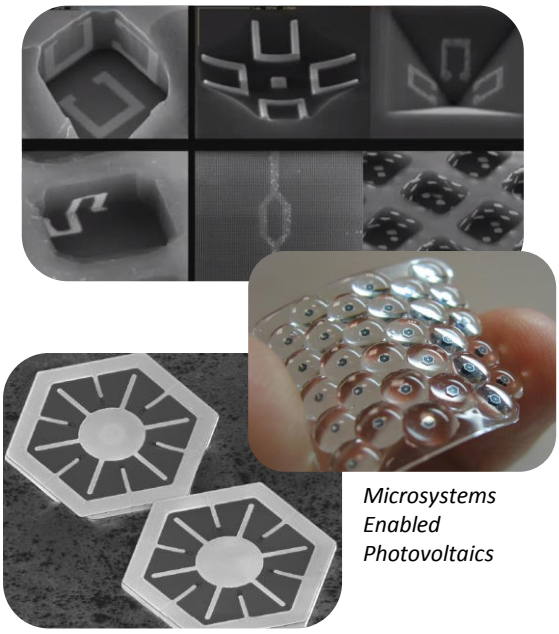
Sandia developed tiny glitter-sized photovoltaic (PV) cells that could revolutionize solar energy collection. The crystalline silicon micro-PV cells will be cheaper and have greater efficiencies than current PV collectors. Micro-PV cells require relatively little material to form well-controlled, highly efficient devices. Cell fabrication uses common microelectronic and micro-electromechanical systems techniques. They are 10 times thinner than conventional cells, yet perform at about the same efficiency.

2011 R&D 100 AWARD WINNER

MICRORESONATOR FILTERS AND FREQUENCY REFERENCES

Sandia's microresonator technology is fabricated using complementary metal-oxide semiconductor (CMOS)-compatible microfabrication techniques. When grouped together, miniature acoustic resonators operate as filters, providing frequency selection in radios and other electronic equipment. When connected with transistor electronics, microresonators can provide frequency reference functions (such as clocking) to radios, microprocessors, and other electronic devices.

Membrane Projection Lithography

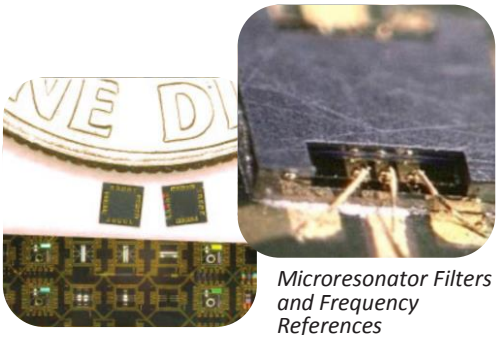


Microsystems Enabled Photovoltaics

R&D 100 award-winning technologies are selected based on "demonstrable technological significance compared with competing products and technologies."

Sandia's Microsystems Science, Technology, and Components organization has been awarded 40 R&D 100 awards since 1986.

For additional information, visit our website at: **www.sandia.gov/mstc**



Microresonator Filters and Frequency References

MICROSYSTEMS SCIENCE, TECHNOLOGY & COMPONENTS

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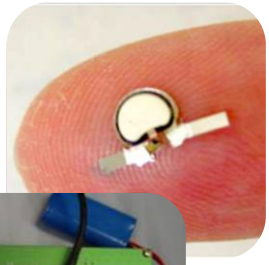
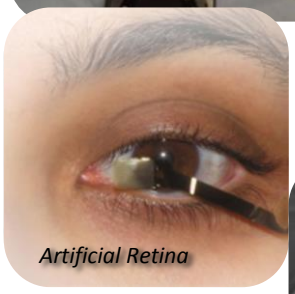
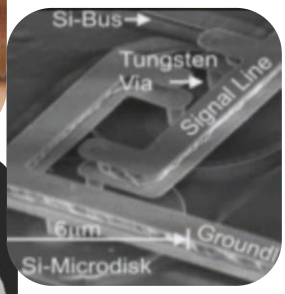
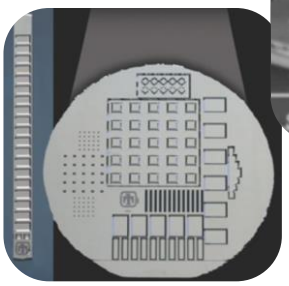


Acoustic Wave Biosensor for Rapid Point-of- Care Medical Diagnosis



Ultralow-Power Silicon Microphotonic Communications Platform





Silicon Micromachined Dimensional Calibration Artifact for Mesoscale Measurement Machines

2010 R&D 100 AWARD WINNERS

ACOUSTIC WAVE BIOSENSOR FOR RAPID POINT-OF-CARE MEDICAL DIAGNOSIS

Sandia's Acoustic Wave Biosensor is a handheld, battery-powered, portable detection system capable of multiplex identification of a wide range of medically relevant pathogens and their biomolecular signatures—viruses, bacteria, proteins, and DNA—at clinically relevant levels. 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.

MICRO POWER SOURCE

Sandia's Micro Power Source is a rechargeable ultra-small form factor power source that integrates a lithium-ion-based solid electrolyte battery with an ultra-thin photovoltaic cell as an energy harvester, enabling micro-devices to become active (rather than passive) participants in their environments. 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.

2009 R&D 100 AWARD WINNERS

ULTRALOW-POWER SILICON MICROPHOTONIC COMMUNICATIONS PLATFORM

Sandia's Silicon microphotonic modulators and bandpass switches establish a platform of ultralow-power silicon microphotonic communication elements capable of addressing the bandwidth and power consumption problems of high-performance computer and data communication networks. Silicon resonant modulators demonstrate for the first time 100-microwatts/gigabit/second optical data transmission on a silicon CMOS-compatible platform.

ARTIFICIAL RETINA

To help those suffering from retinal degenerative diseases, Sandia created a bio-electronic retinal implant using application-specific integrated circuits to convert digital images into electrical signals in the eye enabling the brain to create a visual image. Sandia is developing MicroElectroMechanical Systems (MEMS) and high-voltage subsystems for advanced artificial retina implant designs. These include microtools, electronics packaging, and application-specific integrated circuits (ASICs).

2008 R&D 100 AWARD WINNERS

SILICON MICROMACHINED DIMENSIONAL CALIBRATION ARTIFACT FOR MESOSCALE MEASUREMENT MACHINES

The Sandia MEMS-based three-dimensional physical artifact is designed to help improve measurement accuracy for miniaturized devices, such as fuel injectors, watch components, and inkjet printer parts and 10 times more accurate and much less expensive than the former gold standard and can be used to calibrate a variety of inspection systems.

2007 R&D 100 AWARD WINNERS

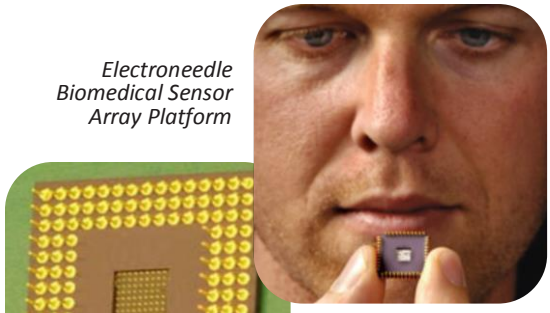
ELECTRONEEDLE BIOMEDICAL SENSOR ARRAY

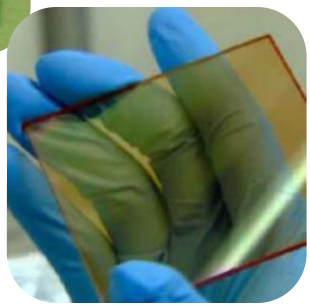
When pressed against a patient's skin, an ElectroNeedle® patch can detect and identify biological markers just beneath the skin's surface. Because the electrochemical analysis is accomplished in situ, the need to withdraw body fluid is eliminated. The height of the needles, adjustable during microfabrication, allows the biological recognition layer to be placed in intimate contact with the appropriate tissue beneath the skin's surface.

SELF-ASSEMBLING PROCESS FOR FABRICATION TAILORED THIN FILMS

Sandia's Self-Assembling Process for Fabricating Tailored Thin Films is a simple, economical nanotechnology coating process that enables development of optical, electrical, and magnetic thin films from self-assembled nanoparticles with architectures and properties unattainable by any other processing methods.

Electroneedle Biomedical Sensor Array Platform





Self-Assembling Process for Fabrication Tailored Thin FilmsPlatform

U.S. DEPARTMENT OF ENERGY | NNSA National Nuclear Security Administration

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