Lewis News

Vol. 10 No. 27 December 28, 1973

Group, individuals merit achievement awards

Center Director Bruce T. Lundin (right) presents achievement certificates to Seth B. Wise (left) and Frank A. Friswold. (Paul Riedel photo)

Center Director Bruce T. Lundin presented a group award, individual monetary awards as well as certificates to employees for superior job performances in ceremonies held in the Administration Building Auditorium earlier this month.

The group award went to 60-40 Inlet and TF-30 Engine Test Team for "Theo outstanding success achieved on the first wind tunnelo test ever of a combinationo of a turbofan engine and ao mixed compression inlet." The citation continues, "This talented team planned and executed one of the most difficult 10 x 10 Supersonic Wind Tunnel undertakings in terms of complexity of hardware, diversity of test objectives, integrated digital control, and conducted in an efficient, productive and safe test program."

The test team consisted of Charles R. Alderman, Dale J. Arpasi, Peter G. Batterton, Robert J. Baumbick, Melvin C. Broniman, Wilbur J.oClark, William G. Costakis, Carl J. Daniele, Roccoo DeLiberato, Steve Conczyo and Robert S. Gray.o

Fred Guska, Raymond J. Karabinus, Paul A. Karla, Robert J. Kinas, William M. Korhely, Frederick D. Kubiak, Daniel H. Metzger, Harvey E. Newmann, Jerald S. Palmer, Frank J. Pultz, Mauri K. Raita, Ross R. Ritchey, William P. Sexton, Jr., Robert J. Shaw, Frank V. Slam, Henry R. Smith, Charles J. Stauffer, Gilbert J. Vasek, Joseph F. Wasserbauer, Donald T. Worden, Frank A. Zelko, and Gregory F. Kelbach, Jr.

Individual employees receiving special achievement awards for some aspect of superior job performance are Paul T. Hacker, Eileen M. Norris, Klaus H. Gumto, Gerald J. Lenhart, Jack S. Grobman, Joseph F. Wasserbauer, Robert B. King, Martin U. Gutstein, J. Anthony Powell, Paul F. Sikora, Ronald Kochensparger, Donald L.o Thoennes, William L.o Whieldon, John P. Greissing, Dominic J. Sozio, Howard F.o Kilpatrick, Clarence A.o Nolan, Gerald L. Matusik,o John D. Noonan, Robert J.o Wills, John B. Pavlik, ando Janet E. Bartels.o

Robert C. Johnson (left), Gustave (Gus) C. Fralick and Andrew J. Szaniszlo, review computer outputs regarding dynamic gas flow direction sensor.

Measuring up...

The Advanced Instruments Research Branch, which probably has more employees holding advanced degrees than any other branch its size, is involved in research to develop instrumentation and measurement techniques for use in many applications.

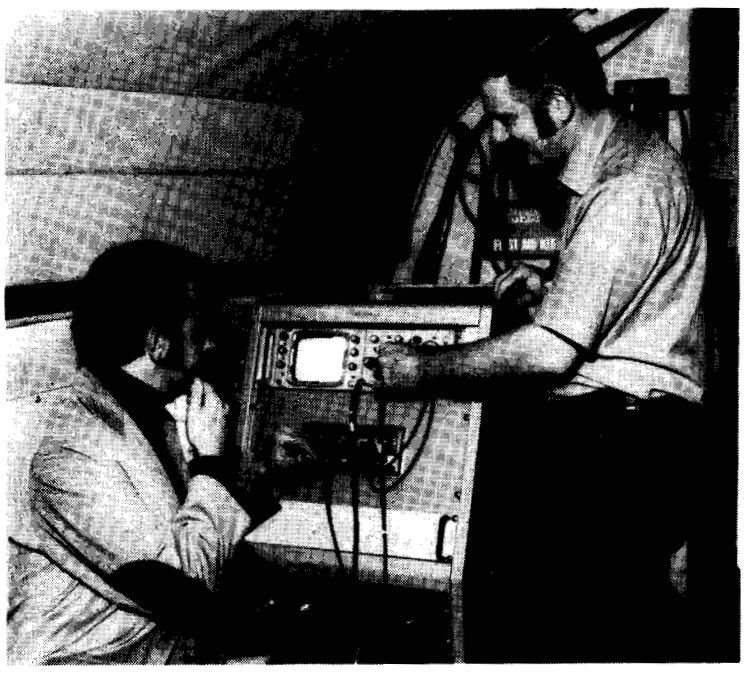
Branch members develop new instruments, principally for the Center's aeronautical programs, when special types needed for research projects are not available on the commercial market.

The branch is headed by Dr. Norman C. Wenger and is composed of electrical engineers, mechanical engineers, and physicists.

Dr. Wenger stated that the branch's bread and butter programs consist of research on instruments for measuring gas pressures, temperatures and flow rates.

"About one-third of our effort is involved with improving standard techniques such as thermocouples for temperature measurements and crossed hot wire anemometers for flow direction. Another third of our effort is devoted to exploring advanced techniques — particularly laser-based remote sensing instruments which can measure temperature or velocity of gas at a remote point in space," Dr. Wenger explained.

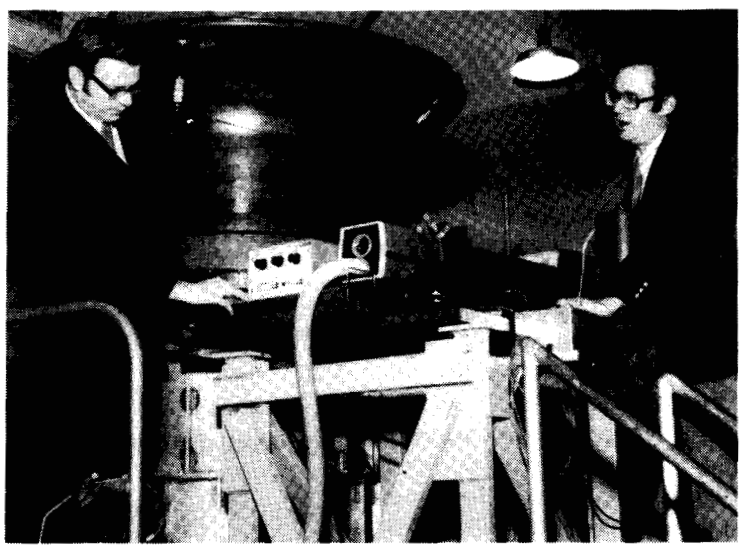
Other programs include developing instruments for turbine and compressor safety which requires measuring disc cracks and blade tip clearance while a turbomachine is operating. In addition, a pulse radar system was developed for use in the Center's C-47 aircraft to measure ice thickness on the Great Lakes.



Dale W. Cooper (left) and Paul H. Zbasnik check Pulse Radar inside Lewis' C-47 aircraft. Instrument is used to measure ice thickness on Great Lakes.

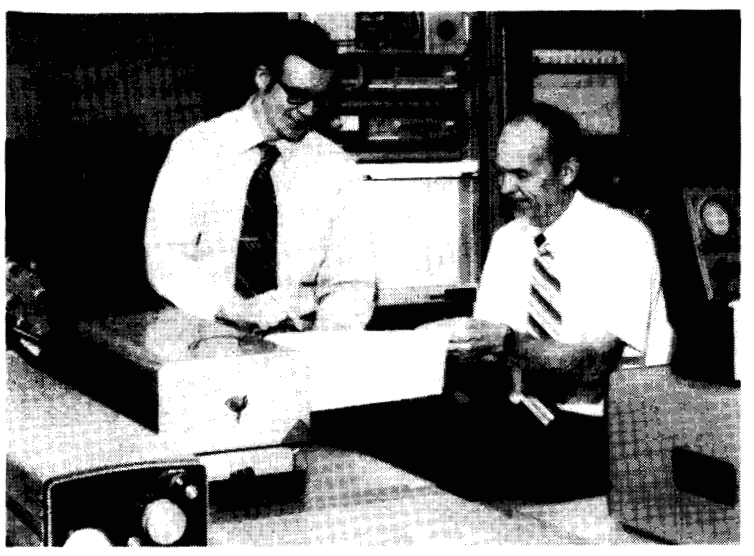
...with instruments

Arthur J. Decker (left) and Dr. Norman C. Wenger with holography system for studying compressor blade flutter.



J. Anthony (Tony) Powell (left) and Dr. Richard G. Seasholtz inspect the Laser Doppler Velocimeter for measuring gas velocities.

Dr. John P. Barranger checks turbine disc crack detection system.



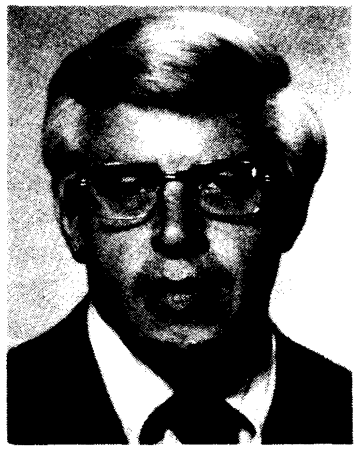
Dr. Herbert Will (left) and Lloyd N. Krause use Laser-Raman Experiment to measure gas temperatures.

Raymond Holanda (left) and George E. Glawe examine sputter coated film thermocouple for turbine blade temperature measurements.

Photos by

John Marton

Dr. James W. Blue



Norman T. Musial

NASA Inventors' Award is Musial's brainchild

The second annual NASA Inventor of the Year awards were presented at an Inventor's Day Exposition in Washington, D.C. last month. This is a program conceived by Lewis Patent Counsel Norman T. Musial.

Names of this year's winners will be announced in the next issue of the *Lewis News.*

The winning patents, selected by a blue ribbon panel at NASA Headquarters, were also entered in the prestigious award competition of the Association of Invention and Innovation.

Dr. James Blue was one of the 1976 finalists considered by the Headquarters panel. Dr. Blue received a patent on a method of producing Iodine 123. Persons finally selected as NASA Inventors of the Year for 1976 were Dr. Robert T.oJones of Ames for his "Oblique-Wing Supersonic Aircraft" patent and Dr. Richard T. Whitcomb for his "Airfoil Shape for Flight at Subsonic Speeds."o

Locally, Lewis inventors will again be honored by a "Lewis Inventors Day Awards Luncheon" on March 29 in the Main Cafeteria small dining room. The Lewis inventors will be represented by patentees who received patents in 1976. These patentees will receive plaques showing an embossed replica of the first page of their patents from Center Director Dr. Bruce T. Lundin.

Those receiving plaques are: William J. Anderson, Bruce Banks, Dr. James W. Blue, Henry Brandhorst, Jr., Jacob Broder, Salvatore Grisaffe, Stanley R. Levine, Lawrence P. Ludwig, Stanley J. Marsik, Dr. Charles E. May, Dr. Warren H.oPhillip, John L. Power, J. Anthony Powell, Harold E.o Sliney, Andrew Terpay, Lawrence H. Thaller, and Herberto A.oWill.o

'Thanks for going extra mile'

Technology Utilization and Public Affairs Director Dr. Walter T. Olson recently presented monetary awards to scientists and engineers who have had a paper covering technical innovations which may be useful to business and industry published in NASA's quarterly *Tech Briefs.*

Dr. Olson also expressed appreciation to a group of the Tech Brief award winners in a December ceremony held in the Administration Building.

He told the winners, "Thank you for going the extra mile with a piece of technology. NASA seeks to maximize the use of your innovative work. The magazine, *Tech Briefs*, is one way that business and industry are alerted to the existence of valuable aerospace technology."

Names of winners and the title of their Tech Briefs are as follows:

Art G. Birchenough, "Simple, Accurate Electronic Analog Divider Circuit for Low Divisor Values;"

Henry W. Brandhorst, Jr. and **Cosmo R. Baraona,** "Low Reflection Silicon Solar Cell System;"

Joseph R. Stephens and **Walter R. Witzke**, "Tough, Strong Iron Alloys for Cryogenic Service;"

Technology Utilization and Public Affairs Director Dr. Walter T. Olson (left) congratulates Erwin V. Zaretsky (center) for his eleventh Tech Brief Award and Richard J. Parker for his sixth Tech Brief Award. (Don Huebler photo)

Louis R. Ignaczak, "Portable Spark-Gap Arc Generator;"

Ira T. Myers and **William T. Harrigill, Jr.**, "Unique Circuit Regulates Voltage of DC-DC Converter;"

John C. Sturman, "Inexpensive Pulse Train Converter for Measuring Analog Voltage," and "Simple Constant Current Regulated Power Supply;"

Robert L. Bowman and **John R. Jack**, "Energy Conservation Using Remote Thermal Scanning;"

Donald, H.E. Priebe, "Simple Constant Current Regulated Power Supply;"

Donald H. Hardy, "Inexpensive Solid State Monitoring Circuit;"

Robert L. Summers, "Modification of Chemiluminescent NO Analyzers to Accurately Measure NO_X;"

Bernard J. Hamrock, "Formula to Determine Minimum Film Thickness for Fully Flooded Ball Bearings, Gears and Cams;"

James J. Pelouch, Jr., "ASRES-ASRDI Safety Document Retrieval and Reporting System;"

Erwin V. Zaretsky and **Richard J. Parker**, "Restoration of Bearings;"

Edward F. Baehr, "Flow Compensating Pressure Regulator;"

Paul F. Penko, Meyer Reshotko and **James W. Coats,** "Instrument for Measuring Dynamic Pressure Fluctuations in a Heated and Pressurized Gas Flow;"

J. Anthony Powell, "Electronic Shaft Angle Encoder;" and

Porter Perkins, Jr., Ted W. Nyland and **Marvin W. Tiefermann**, "Airborne Atmospheric Sampling System."

NASA

Lewis Research Centers
Cleveland, Ohio

March 28, 1980

Inventors' Day luncheon set

Thes fifths annuals Lewis Inventorss Day Award Luncheon will beshеldsApril 8 ins thes Mains Cafeteria Small Dining Room.

Twentys inventorss will re-ceive plaquess withs an em-bosseds replicas ofs the first pages ofs their respectives patentss from Centers Direc-tors Dr.s John F.s McCarthy, Jr.

NASA-wide,s Dr.s Los I. Yins ofs Goddard Space Flights Centers wass selected ass thes agency'ss Inventor of thes Years fors hiss invention of the LIXIscope.

Lewis inventorss receiving plaquess are Donalds L. Alger,s Edwards F.s Baehr, Roberts C.s Bill,s Johns C. Evans,s Jr.,s Edwards R. Fur-man,s Ambrose Ginsburg, retiree,s Robert P.s Gruber, William F. Hady,s Melvin J. Hartmann, Li-Chens Hsu, Lawrence P. Ludwig,s Brent A. Miller, Warrens H. Philipp,s J. Anthony Powell,s Deans W. Sheibley, Harold E.s Sliney, Joseph R.sStephens,s Warner L.s Stew-art,s Lawrences H. Thaller and Walter R. Witzke.s


DONALD L. ALGER


EDWARD F. BAEHR


ROBERT C. BILL


JOHN C. EVANS, JR.


EDWARD R. FURMAN

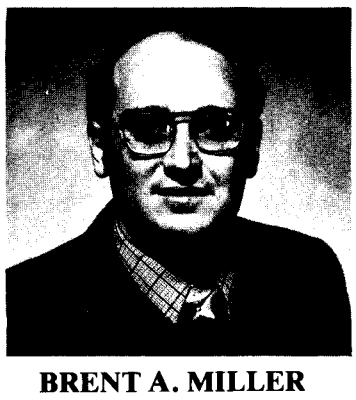

ROBERT P. GRUBER


WILLIAM F. HADY


MELVIN J. HARTMANN


LI-CHEN HSU


LAWRENCE P. LUDWIG


BRENT A. MILLER


WARREN H. PHILIPP

Fifth Annual Inventors Award Ceremony

Tabletop view of the award luncheon on April 8 which honored 19 Lewis inventors.

Nineteen Lewis inventors were honored at the Fifth Annual Inventors Award Luncheon held April 8 in the Small Dining Room of the Main Cafeteria.

Center Director Dr. John F. McCarthy, Jr., congratulated the inventors and later presented them plaques that carried an embossed replica of the first page of the inventors' patents.

Lewis Patent Counsel Norman T. Musial began the annual inventors award event at Lewis. The idea caught fire and is now an annual NASA-wide function.

Lewis Office of Patent Counsel


GENE SHOOK, SR.
Patent Advisor


NORMAN T. MUSIAL
Patent Counsel


JAMES A. MACKIN
Patent Advisor


MILDRED C. HUTCHISON
Administrative Assistant

"He that invents a machine augments the power of man and the well-being of mankind." **H.W. Beecher**


J. ANTHONY POWELL

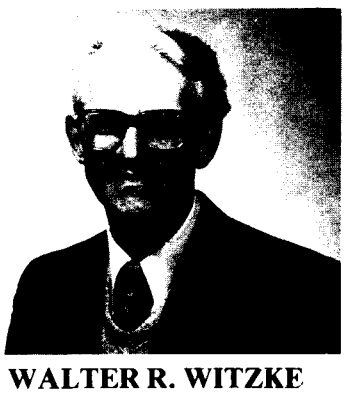

DEAN W. SHEIBLEY


HAROLD E. SLINEY


JOSEPH R. STEPHENS


WARNER L. STEWART


LAWRENCE H. THALLER


WALTER R. WITZKE

Major awards . . .

(*continued from page 1*)
supportive aid in the design and evaluation of turbomachinery for advanced technology propulsion systems for aerospace vehicles including the Space Shuttle."

The three teams receiving group achievement awards are the following:

•Engine Component Improvement Project Office "for outstanding accomplishments in the development of aircraft propulsion technologies which will result in substantial fuel savings and help maintain U.S. leadership in aeronautics."

Engine Component Improvement Project Office team members Joseph A. Ziemianski, Robert J. Antl, Frank J. Barina, Robert C. Bill, Robert P. Dengler, Walter H. Fenning, Irwin K. Frey, Frank J. Hrach, John E. McAulay, Charles M. Mehalic, Donald L. Nored, William M. Prati, Dean C. Reemsnyder, G. Paul Richter, Jack P. Shinn Kenneth E. Skeels, Edward G. Stakolich, Thomas N. Strom, Irving E. Sumner, Edward M. Szanca and Diane M. Verlei.

•QCGAT Project Office "for an outstanding contribution to general aviation turbofan technology with emphasis on reduced engine noise and emissions and improved performance."

QCGAT team members are Kaleel L. Abdalla, Donald L. Bresnahan, Edward T. Calmer, John J. Coy, James S. Fear, Edward R. Hersman, Lawrence M. Hibben, Robert W. Koenig, Eugene A. Krejsa, Anthony Long, Lawrence P. Ludwig, Royce D. Moore, Harold E. Rohlik, Francis S. Stepka, Dennis P. Townsend and Michael R. Vanco.

•Spacecraft Environment Section "in recognition of its significant contributions in developing means of understanding and controlling detrimental interactions between geosynchronous satellites and the space charged-particle environments in which they operate, thereby helping to prolong satellite mission lifetimes and improving system operational reliability."

Spacecraft Environment team members are Norman T. Grier, Carolyn K. Purvis, James C. Roche and John V. Staskus.

Among other distinctions conferred, Victor Gordon, deputy director for resource and financial management, and C. Robert Morse of the Aerothermodynamics and Fuels Division received emblems for 40 years of government service.

Also recognized were J. Anthony Powell, Richard G. Seaholtz and Anthony J. Strazisar for co-authorship of the best Lewis technical publication in 1980: "Efficient Laser Anemometer for Intra-Rotor Flow Mapping in Turbo Machinery."

Center Director Dr. John F. McCarthy, Jr. served as master of ceremonies and presented the NASA agency awards. Deputy Director Dr. John M. Klineberg presented the 40-year service and best publication awards.

Scheduled guest speaker for the occasion was Rear Admiral Anthony F. Fugaro, District Commander of the U.S. Coast Guard, who added remarks of appreciation as co-chairman of the Cleveland Federal Executive Board.

NASA
Lewis Research Center
Cleveland, Ohio

December 3, 1982

Lewis physicists break high-temperature electronic barrier

A team of Lewis physicists has developed a repeatable, practical manufacturing process for high purity silicon carbide semiconductors — a discovery which may vanguard the development of a new breed of heat-resistant electronics.

Semiconductors, the tiny electronic "chips" small enough to pass through the eye of a needle, are the heart of modern microelectronics and are used in everything from computer toys to complex spacecraft guidance systems.

Until now, most semiconductors have been made of pure silicon, the main ingredient of beach sand.

Unrivaled in purity, these silicon chips, however, are adversely affected by heat. Electronics using silicon semiconductors are destroyed by temperatures above 600 degrees Fahrenheit.

Scientists say that by using semiconductors made of silicon carbide, electronic packages should be capable of enduring temperatures as high as 1,600 degrees F (lead melts at 620 degrees F).

"High temperature electronics based on silicon carbide semiconductors will be of great value to a wide variety of users," said Lewis physicist Bill Nieberding who, with physicists Tony Powell and Herb Will, has been intensely involved in the development of a new process.

"High-temperature electronics could give Lewis the ability to place electronic packages and switches inside experimental turbine engines to both monitor and control the engine to a degree never before possible," Nieberding said.

Silicon carbide semiconductors will also be valuable in improved instrumentation for nuclear-powered generators — both in space and on the ground.

High-temperature electronics could enable NASA to build planetary probes able to withstand the searing heat encountered on the surface of planets like Venus or Mercury, he added.

The search for a practical production process for silicon carbide semiconductors is not new. Researchers in the 1950's realized how sensitive silicon electronics were to heat and set out to find a semiconducting material that was capable of withstanding higher temperatures.

One of the materials considered was diamond, but natural diamonds are far too expensive to use as a semiconducting material and the man-made variety lack purity and other essential properties.

The Air Force was the driving force behind much of the early research into silicon carbide semiconductors in the 1950's.

Their reason: without high-temperature electronics, supersonic jets need exotic cooling systems to protect their avionics.

Continued on page 3

Opening a new frontier

Continued from page 1

Cooling methods include pumping highly flammable jet fuel around the aircraft's electronics to absorb damaging heat.

The early silicon carbide efforts were a failure because sufficiently pure crystals of silicon carbide were impossible to make and the experimental production methods were not repeatable, according to Powell.

Research on finding a repeatable process continued in labs all over the world during the 1960's but was abandoned in the U.S. in 1973.

Research into high-temperature electronics high-temperature semiconductor, according to Powell.

"At the same time the program was revived, we received a request from a Japanese physicist to join us at Lewis on a research fellowship," Powell said. "He had been doing advanced research into silicon carbide with a unique idea."

Dr. Shigihiro Nishino was quickly granted the fellowship and spent the next 15 months at Lewis working with Nieberding, Powell and Will on adapting his novel idea of making the elusive silicon carbide semiconductor.

Nishino's theoretical that could later be deposited above it.

The main stumbling block in this process, according to Nieberding, was that the spacing between atoms of the two materials was significantly different, which caused the upper layer of deposited silicon carbide to break into tiny unusable pieces. The resulting uneven surface destroyed the material's ability to act as a semiconductor.

"Nishino's efforts involved first laying down a very thin buffer layer of irregular silicon carbide crystals over the silicon substrate," Nieberding explained.

The buffer layer of tiny crystals (about 10,000 times thinner than a human hair) would act as a bridge between the two slighty different crystal structures.

This Lewis international group of scientists worked several months in the IRL constructing the lab that would permit them to perfect a way of depositing the buffer layer and the subsequent layer of silicon cabide.

Their process began by heating a pure silicon wafer in a radio frequency heated oven and then injecting selected gases to form the silicon carbide crystal buffer layer.

The result was a film surface upon which other gases introduced into the oven could later deposit a uniform layer of pure silicon carbide crystals — thus forming the elusive silicon carbide semiconductor.

The involved and highly controlled process requires about six hours.

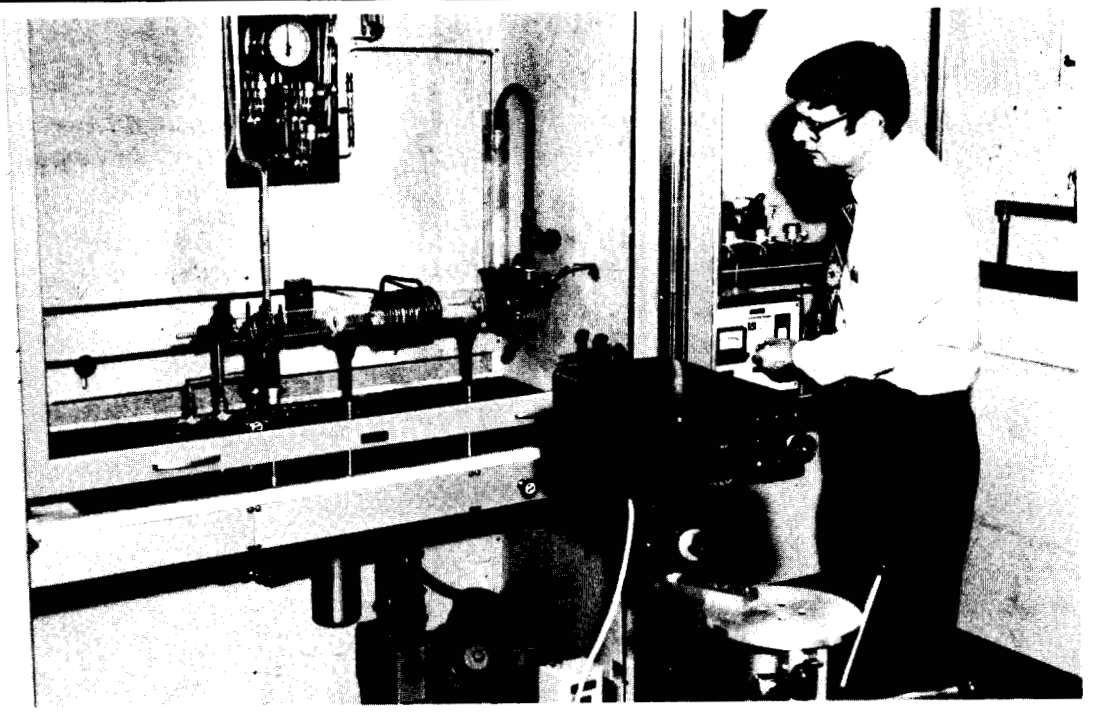
"With Nishino's idea and our experience from past efforts we were together able to develop a repeatable process rather quicky," Powell said.

The results of the program will be officially published in a scientific journal where other researchers can benefit from the Lewis discovery.

Nieberding, Will and Powell have used the silicon carbide produced in their rig to build diodes and other devices for evaluation.

"Early indications show that our efforts have been a success," Powell said, adding that their work has really just begun. "Now we are looking at ways to make the process more efficient."

Like many other technical innovations, no one is sure just how valuable the silicon carbide chip will be, but even the most conservative estimates indicate that Lewis may have opened the door to a new world of high-temperature electronics.



Tony Powell monitors the process by which a sample of silicon carbide is made in the experimental facility he and Dr. Will designed. Gases used in the manufacturing process are introduced into the quartz heating chamber via a network of tubing on the right end. The silicon base material rests on a graphite bed inside the copper coils of the radio frequency elements. *Don Huebler photo*

What is a semiconductor?

Semiconductors, or "chips," are the fundamental elements of all modern computers.

In this role they serve as switches that store or route information in a binary language by being either open or closed in a coded sequence.

Semiconductors can do this because their ability to conduct an electric current can be controlled.

Unlike copper--also a conductor, or rubber--which is an insulator, semiconductors play both sides of the field.

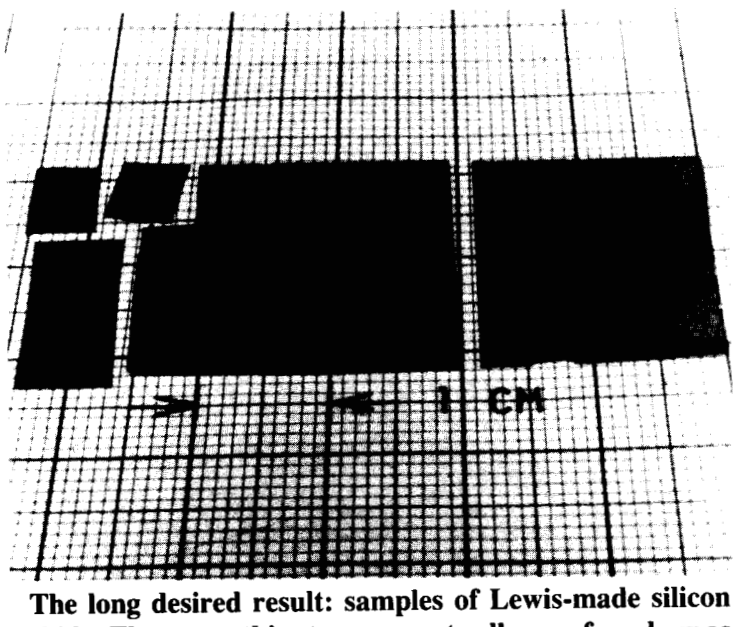
A specific amount of current must be brought to bear upon the semiconductor switch to excite its atomic structure into a conducting state - or open switch position.

Germanium, silicon, diamond and silicon carbide are among the few materials that have this unique property.

By building many such switches upon a single, tiny chip, vast amounts of information can be stored for later use.

based on silicon carbide was resumed in America two years ago when the Navy and NASA began looking for ways of putting computers in direct, on-line control of jet engines.

When work resumed, silicon carbide was still considered by NASA to be the best bet in the search for a process began by using standard silicon disks as a substrate for the construction of the silicon carbide semiconductor. This was similar to other, unsuccessful methods tried in the past. Pure silicon was desirable as a base because it would impart its highly regular crystal structure to the silicon carbide



The long desired result: samples of Lewis-made silicon carbide. The super-thin, transparent yellow wafers show as darker areas of the photo.

Silicon carbide: Boon to communications?

A technical symposium held recently to discuss Lewis' silicon carbide innovations revealed a possible new, and more extensive, application for the super semiconductor - communication electronics.

Physicists working on extremely high frequency communications believe silicon carbide may prove to be a key element in developing frequency bands measured in Terrahertz, or trillions of cycles per second.

Normal radio and television broadcasting is done on the Kilohertz and Megahertz bands (thousands and millions of cycles per second respectively). Gigahertz band communications (billions of cycles per second) is just coming into use, primarily for satellite applications.

Silicon carbide's communication applications could also prove to be more extensive in terms of dollars invested.

"For every dollar invested in high-temperature electronics," Neiberding said, "there are 100 dollars spent on communications."

Work on silicon carbide's high-frequency communications applications is still in the experimental stage. Scientists hope Terrahertz frequencies could solve the growing problems of crowded airwaves.

Lab surpasses 1982 CFC goal

Lewis once again showed the Cleveland federal district that it was a major center for generosity during the 1982 Combined Federal Campaign.

At last count, $309,456 - more than 102 percent of the goal - was pledged.

The participation level was almost 87 percent.

Lewis CFC Chairman Robert Finkelstein said the tally doesn't even include the confidential contribution figure, which amounts to several thousands of additional dollars.

"True to the traditional spirit of giving at Lewis, we met and surpassed our goal this year," he said.

Retirees contributed $1,805 to the total.

A final figure has not been released by the CFC director to date, according to Finkelstein, who added that CFC contributions are still coming in.

News Notes

High temperature electronics talk

Lewis Physicist Tony Powell will present a Research Briefing on an "Improved Crystal Growth Process for Cubic Silicon Carbide," a crucial element needed to create a new family of electronics capable of withstanding the high temperature environment of jet engines and other hot applications. The 30-minute briefing, open to anyone interested, will be held March 2 at 11 a.m. in the Ad. Bldg. Auditorium.

Lewis research earns four IR-100 awards

Continued from page 1

Powell and Will's silicon carbide development (**Lewis News,** Dec. '82) describes a repeatable process for making semiconductors of silicon carbide that have much higher temperature tolerances than semiconductors currently available.

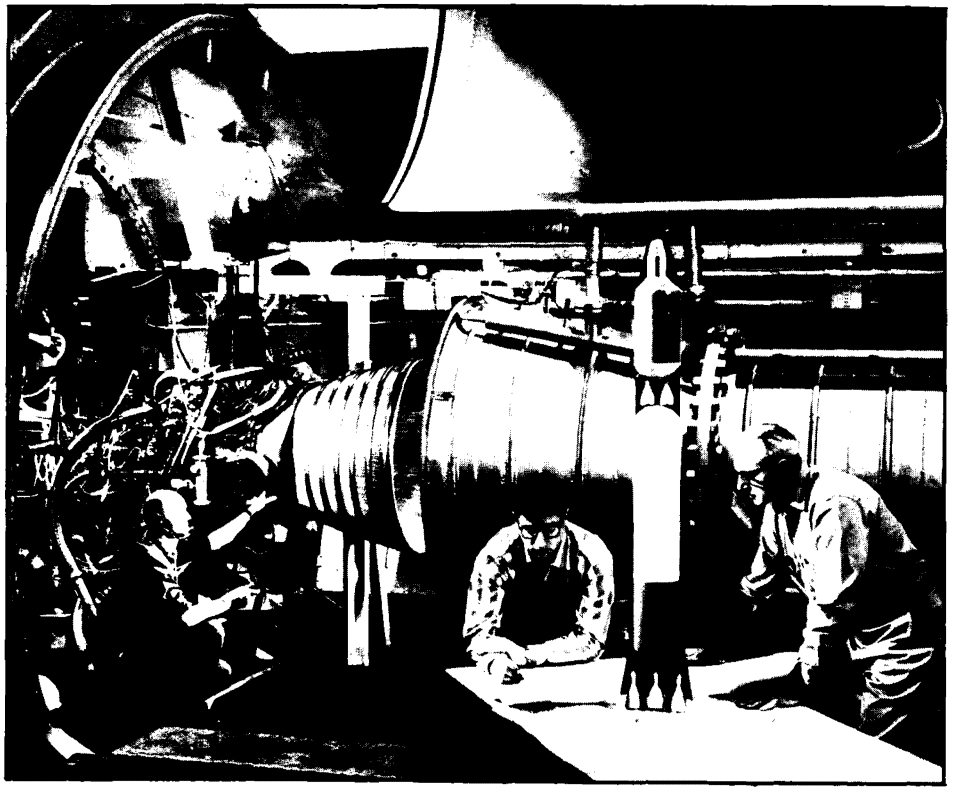
With such devices, electronic components can be built that will be capable of operating in harsh, high-temperature environments such as those found in turbine engine hot sections, deep well drilling and spacecraft communications applications.

"System for High-Speed Balancing of Shafts" is a process that uses lasers to correct imbalances so that shafts and rotors run more smoothly and more accurately at all operating speeds. Its key feature is a computer-controlled pulsed laser that can remove materials from the shaft at up to five axial locations and correct balance at remote locations that are impossible to reach by other means.

The system can be applied to balancing high speed rotating machinery, turbo chargers, gyroscopes, turbo compressors and aircraft gas turbine rotors.

"High-Frequency, High-Power Capacitors" are high-voltage devices that enable small, lightweight electronic components to produce larger power output in space power applications. The capacitors also have many terrestrial applications.

Lewis' fourth IR-100 award winner -- "High-Speed Switch Matrix System" -- is an improved technique for routing messages among many ground terminal users throughout the continental United States using a geosynchronous communications satellite. The new technique greatly increases the throughput capability of a satellite and enhances the efficient utilization of the available communications frequency spectrum.



25 YEARS OF NASA - Lewis Propulsion Systems Laboratory personnel prepare for a test firing of Lewis' RL-10 engine in one of the PSL tanks in this 1962 photo. The RL-10 was the first rocket engine to burn liquid oxygen and liquid hydrogen as fuel. This high-energy fuel technology was applied to other, more powerful, engines that took astronauts to the moon and that now power the Shuttle. The model in the foreground depicts a Centaur upperstage, powered by two RL-10's, mated to an Atlas booster.
Marty Brown photo

PROCESSES

Buffer layer may open SiC uses in electronics

SILICON CARBIDE, a tough, heat-resistant material, is not exactly begging for new applications. The unique properties of silicon carbide (SiC) make it a highly desirable material for demanding, critical-wear environments.

Now, researchers at NASA-Lewis Research Center, Cleveland, OH, have developed a process for making silicon carbide semiconductors. The process, while still in early R&D stages, could open up an important new application for silicon carbide—high-performance electronics.

With the exception of gallium arsenide (GaAs) as a semiconducting material, pure silicon is the main material used to fabricate electronic chips. While unrivaled in purity, these silicon chips, however, are sensitive to heat. Electronics using silicon semiconductors are destroyed by temperatures above 600 F (315 C).

With this limitation in mind, researchers, since the 1950s, have been trying to make useful electronic devices with silicon carbide as the semiconducting material. Some scientists agree that by using SiC semiconductors, electronic packages could endure temperatures as high as 1600 F (870 C).

Yet, while the potential has been great, the research effort to develop a process for making the elusive SiC semiconductor has fallen short of its goal. The main stumbling block has been the difficulty in growing silicon carbide in a single-crystal form.

Early research focused on depositing SiC on a silicon wafer, with the idea that the silicon would transmit its single-crystal structure to the SiC. What the researchers found, however, is that the spacing between the atoms of the two materials is significantly different for electronic applications. NASA-Lewis physicist Bill Nieberding told *IR&D*, "There is a 20% difference in the atomic spacing between the two materials, which in previous work caused the upper layer of silicon carbide to break into tiny, unusable pieces. The resulting uneven surface destroyed the material's ability to act as a semiconductor."

Nieberding, along with Anthony Powell and Herbert Will of NASA and Japanese physicist Shigihiro Nishino, developed the new process. It was Nishino's innovation of a buffer layer between the silicon and silicon carbide materials that keyed the development.

Rather than form a SiC device directly on the silicon substrate, the researchers decided to put down a buffer layer of silicon carbide first. "This buffer layer, measuring between 10- and 20-nm thick, acts as a bridge between the two slightly different crystal structures," Nieberding explained.

"We do not fully understand the role of the buffer layer in this work. We have a lot of ideas of what it does, but no concrete evidence yet.

"We believe that the buffer layer reduces the stress between the atomic arrangement of the two materials. We are fairly sure that the regularity of silicon is transmitted, but weakened, through the SiC buffer layer to the SiC — grown on it. But this is all speculation," he added.

The researchers began by constructing a small lab that would allow them to perfect Nishino's theoretical process of depositing a buffer layer and the subsequent layer of silicon carbide. The process that finally evolved centers around heating a pure silicon wafer in a radio frequency-heated oven, and then injecting selected gases to form the SiC buffer layer. The result is a film surface upon which other gases are later deposited to form a pure silicon carbide crystal. The process takes about six hours to complete.

A critical aspect of the process is control over working parameters, such as temperature and flow of gases, Nieberding explained. "Control must be very precise in order to deposit the buffer and then grow SiC on it. Attention to detail makes all of the difference."

While some of the mechanics of what the buffer layer does do remains vague, potential applications for SiC devices are many. Among its unique properties, SiC has the ability to handle extremely high frequencies. For communication electronics, SiC semiconductors could open up a whole new range of frequency bands in the hundreds of gigahertz. For computer electronics, this high-frequency range could mean faster and more-powerful computers built with SiC semiconductors.

"Silicon carbide electronics could also give us the ability to place electronic packages and switches inside experimental turbine engines to monitor and control the engine to a degree never before possible," Nieberding said.

"They also could be valuable for improved instrumentation of nuclear power generators, as well as enable researchers to build planetary probes that can withstand the searing heat encountered on planets such as Venus or Mercury."

But Nieberding stresses that usable devices made of SiC have yet to be built. "We have made some P-N junctions, but not anything that would resemble a practical device. We are still working on materials characterization. Right now we are more interested in what makes the buffer layer do what it does," he added.—*Skip Derra* □

High-temp electronics breakthrough among IR-100 award winners

Four Lewis developments have been selected by **Industrial Research and Development** magazine's annual competition as among the 100 most significant new technical developments of the year.

Known as the IR-100 Award, the honor has been given to top research organizations since 1963. Lewis is now sixth among all-time IR-100 winners in the nation with 40 awards. In this year's competition, honoring the most significant developments in 1982, there were over 1,000 entries competing for the 100 awards.

Lewis' winning entries and their developers are:

"Process for Producing Cubic Silicon Carbide Devices" by Lewis researchers J. Anthony Powell and Herbert Will; "System for High-Speed Balancing of Shafts" by David P. Fleming and co-developed by Mechanical Technology, Inc., of Latham, N.Y.; "High-Frequency, High-Power Capacitors" by David D. Renz and co-developed with Maxwell Laboratories, Inc., San Diego, Calif.; and "High-Speed Switch Matrix System" by Ernie W. Spisz and co-developed with Ford Aerospace and Communication Corp., General Electric and Mitre Corp.

Continued on page 4

News Notes

Schuon gets highest grade

Dr. Susan R. Schuon, an engineer in the Materials and Structures Directorate, received the highest grade in the recent metallurgical discipline exam for professional registration conducted by the State Board of Registration for Professional Engineers and Surveyors. Schuon is now a fully accredited member of the Ohio Society of Professional Engineers.

Chamis presents two papers

Christos C. Chamis, a member of the Structures and Mechanical Technologies Division, will present two papers detailing his work in composites at the Reinforced Plastics-Composites Conference and Expo '84, next January in Houston.

The conference is the first composites industry trade show and will feature 125 papers on all aspects of composites technology.

Chamis' two papers -- "Simplified Composite Micromechanics Equations for Strength, Impact Resistance, Fracture Toughness and Environmental Effects" and "Design Procedures for Fiber Composite Structural Components: Membranes, Plates and Box Beams" -- will be presented in the Expo's Advanced Composites section.

Kosmahl honored by CECON

Dr. Henry G. Kosmahl, Lewis physicist credited with pioneering the development of the traveling wave tube and other communication satellite technology breakthroughs, will be awarded the CECON Medal of Achievement at the upcoming Conference for Electrical and Electronic Technologies in Cleveland.

The two-day CECON Conference, scheduled to begin Oct. 4, will feature the latest developments in electronics and computer intelligence technology.

Other Lewis representatives at the conference are Godfrey Anzic, who will present his work in gallium arsenide microwave monolithic integrated circuit technology; E. W. Spisz who will give a talk entitled, "A Satellite Switched SS-TDMA IF Switch Matrix" and Tony Powell who will talk about his recent developments in high-temperature semiconductors. In addition to receiving the award, Kosmahl also will present a talk, "Space Power TWT's -- Very Much Alive."

Dual Career Ladder Staffers

In last month's issue of the ***Lewis News*** *(March 21, pages 1 and 2) 16 Center staffers who received promotions recently under the ongoing* ***Dual Career Ladder System*** *were featured (as will others be in upcoming issues). The Center system allows scientists and engineers to be promoted to grade levels commensurate with supervisory grades without the requirement that they become supervisors. Below is a list of all the other Dual Career GS-14 and GS-15 staffers:*

DUAL LADDER GS-14s

Abdalla, Kaleel L.
Anderson, David N.
Aukerman, Carl A.
Bankaitis, Henrikas V.
Barranger, John P.
Baud, Kenneth W.
Baumeister, Kenneth J.
Behrendt, Donald R.
Birchenough, Arthur G.
Boldman, Donald R.
Borsody, Janos
Boyer, Earle O.
Braithwaite, Willis M.
Braun, Martin, J.
Burkhart, James A.
Cahill, Thomas P.
Calogeras, James E.
Clark, John S.
Cooper, Larry P.
Cunningham, Robert E.
Curtis, Henry B.
Decker, Arthur J.
Dewitt, Richard L.
Dickman, John E.
Dittmar, James H.
Dreshfield, Robert L.
Dudenhoefer, James E.
Dunning, John W.
Dustin, Miles O.
Faddoul, James R.
Flage, Richard A.
Fleming, David P.
Franciscus, Leo C.
Friedman, Robert
Gelder, Thomas F.
Glasgow, John C.
Gordan, Andrew L.
Gordon, Larry H.
Gourash, Francis
Graber, Edwin J.
Gross, Bernard
Hady, William F.
Hagedorn, Norman H.
Heath, Richard W.
Heller, Jack A.
Hendricks, Robert C.
Hoffman, Anthony C.
Holdeman, James D.
Howes, Walton L.
Hrach, Frank J.
Hurrell, Herbert G.
Hyland, Robert E.
Ingebo, Robert D.
Jabo, Robert M.
Johnson, James R.
Jones, William R.
Joyce Joseph P.
Kao, Hsiao C.
Kerwin, Paul T.
King, Robert B.
Krawczonek, Eugene M.
Kurkov, Anatole, P.
Lalli, Vincent R.
Lauver, Richard W.
Loeffler, Irvin J.
Maloy, Joseph E.
Manning, Frank L.
Marek, Cecil J.
Mcardle, Jack G.
Meleason, Edward T.
Merrill, Walter C.
Miller, Robert A.
Miner, Robert V.
Mirtich, Michael J.
Miyoshi, Kazuhisa
Newmann, Harvey E.
Neustadter, Harold E.
Nice, Arno W.
Norgren, Carl T.
Norris, James W.
Orzechowski, Richard E.
Parker, Richard J.
Pater, Ruth H.
Pepper, Stephen V.
Philipp, Warren H.
Pickrell, Roy L.
Porada, Theodore W.
Powell, J. Anthony
Procasky, Edwin R.
Prokopius, Paul R.
Ramins, Peter
Ratajczak, Anthony F.
Reader, Karl F.
Reemsnyder, Dean C.
Reid, Margaret A.

(Continued On Page 3)

Special Achievement Awards Received By 489 Lewis Employees

Lewis employees earned a total of $166,610 through awards granted in the second half of 1987. Superior job performance, a special act or service, or group achievements earned employees the lump-sum cash awards. The following individuals earned Sustained Superior Performance Awards, Group Achievement Awards, or Special Act or Service Awards.

Sustained Superior Performance Awards

Administration and Computer Services Directorate
1360 Joseph Bender

Instrumentation and Control Technology Office
2500 Barbara Mader
2510 Herbert Will

Resources Analysis and Management Office
3140 Jack Herman

Aerospace Technology Directorate
5000 Mary Anne Mulroy
5100 Hubert Probst
5120 Gordon Watson
5150 Kenneth Bowles
5640 Robert Acosta
5650 Ihor Kramarchuk

Space Flight Systems Directorate
6130 Michael Jarrell
6130 Richard Krawczyk
6150 Pete Vrotsos

Technical Services Directorate
7202 Alan Wolfe
7220 Michael Kaltenstein
7230 David Davis
7230 Thomas Lapka
7250 Gerald Schneider
7250 Barry Stephenson
7260 Gerhardt Fiedler
7260 William Parkinson
7260 Kenneth Weiland
7280 Gary Wolf
7301 Ernest Flower
7330 Donald Kwiatkowski
7340 Raymond Stemitz
7350 Andrew Aron
7440 Carl Blaser
7440 Jerome Priebe
7460 Leonard Cramer
7460 Robert Hauer
7610 Daryl Edwards

Special Act or Service Awards

Office of the Director
0100 Deborah Scoarste

Office of External Affairs
0110 Nancy Horansky
0112 Patricia Yacobucci
0113 Linda Ellis

Office of University Programs
0131 Lennart Hultgren

Office of Mission Safety and Assurance
0151 Robert Draper
0152 Wilhelm Benz

Office of Interagency and Industry Programs
0171 Anthony Ratajczak

Administration and Computer Services Directorate
1120 William MacDonald
1130 Anita Arnold
1130 Linda Penczak
1140 Connie Edgar
1140 Merry Sherrod
1330 Vincent Scullin
1330 Carol Sotos
1360 James Emerich
1380 Minna Chao
1710 Margaret Heintz
1710 Steve Lukac
1710 Karen Sherman
1730 Patricia Dimaline
1930 Arthur Laufman
1930 Ernie Walker
1940 Carol Ferch

Aeronautics Directorate
2520 Nancy Piltch
2540 Grigory Adamovsky
2540 Lawrence Matus
2540 J. Anthony Powell
2550 Kevin Melcher
2700 Mary Tharp
2702 Roy Hager
2702 John Whitlow, Jr.
2720 William Olsen, Jr.
2750 Kaleel Abdalla
2760 Daniel Buffum
2770 Beth Cooper
2770 Eugene Krejsa
2850 Ronald Blaha

Office of the Comptroller
3120 Isadore Sonkin
3260 Michelle Britvec
3300 Linda Trimmer
3320 Kenneth DeLaat
3340 Florence Carson
3360 Ronald Alexander
3380 Rita Turske

Engineering Directorate
4010 Denise Farrell
4010 Klaus Gumto
4010 Pamela Mellor
4010 Daniel Vrnak
4020 Georgette Miller
4130 Charles Moon
4310 Frank Shaker

Aerospace Technology Directorate
5120 Frank Ritzert
5120 J. Daniel Whittenberger
5160 James Smialek
5180 Robert Hoover
5200 Cynthia Szanca
5210 Paul Bartolotta
5210 Joseph Grady
5210 Janette Kline
5220 Judy Krugman
5220 Ignacy Telesman
5230 Charles Lawrence
5230 Bruce Steinetz
5230 Marjorie Trujillo
5250 Shari Meyer
5250 Don Roth
5250 Alex Vary
5250 Nancy Wolf
5320 Richard DeWitt
5320 Terry Hardy
5320 Grace Jennings
5320 John Kazaroff
5320 G. Paul Richter
5320 Margaret Whalen
5340 Kevin Breisacher
5340 Diane Galecki
5340 Robert Zurawski
5350 C. Joe Morgan
5400 Carolyn Clapper
5410 Avis Bradfield
5420 Alice Kelley
5420 Michelle Manzo
5420 Margaret Reid
5430 Gale Sundberg
5440 Jerry Winter
5460 Lanny Thieme
5460 William Tomazic
5480 Sharon Rutledge
5620 Raymond Palmer

Space Flight Systems Directorate
6140 Erwin Edelman
6200 Robert Dezelick
6200 Joseph Gaby, Jr.
6200 Richard Knoll
6200 Guy Ribble, Jr.
6520 Kenneth Baud
6700 Joanne Flowers
6710 Paul Greenberg
6720 Gerald Kraft
6730 William Foster II
6740 Lily Facca
6800 Patricia Lewis
6800 Marisa Pischel
6810 Stephanie Black
6810 Robert Cataldo
6810 William Poley
6820 Leslie Balkanyi
6820 Michael Benik
6820 John Hickman
6820 Sandra Hippensteele
6820 Lee Mason
6820 Mark Mulac

Technical Services Directorate
7010 Edward Stevenson
7220 William Darby
7220 Christopher Teodecki
7280 Raymond Gierowski
7280 James Knight
7280 Robert Lavelle
7300 Phillip Kall
7410 Lyle Hoffman
7430 Floyd Smith
7450 Robert Reminder II
7460 Charles Klein
7460 Joseph Ochmanski
7602 Leslie Main
7620 Laszlo Zala
7650 James Gaffney

Space Station Systems Directorate
8520 Michael Skorobatckyi

Group Achievement Awards

PV NiH2 Cell Life Testing Facility
1330 Ronald Abel
1370 Gayle Roth
7250 Robert Buttler
7250 Russell Capelety
7250 Russel Gemeiner
7250 Robert Gott
7250 Eli Green
8630 Tom Miller
8630 Terry Romanofski
8630 Steve Simons
8910 Kenneth Mellott
8910 Gary Pease
8910 Henry Speier

ERBNET Local—Area Network Development Team
1370 Sasi Pillay
1370 Joe Rossoll
1380 Dave Remaklus
1390 Dan Cica
2620 Al Bishop
2620 Dan Whipple
SVER George Mayhew

Mach 5 Inlet Team
2620 Bernhard Anderson
2620 Thomas Benson
2780 Robert Coltrin
2780 Bobby Sanders
2780 Lois Weir
2830 Kenneth Baskin

Obligation Fund Control
3210 Mary Beth Celebrezze
3210 Joseph Kan
3210 Rosemary Kreidler
3210 Agnes Quint

GOES SEB Group Award
0100 Linda Graham
0100 Elaine Pappas
0120 Edward Zak
0151 Henrikas Bankaitis
3320 Robert Lisy
3330 Thomas Tokmenko
4210 Richard Dillon
4310 James McAleese
5410 David Brinker
6510 Edwin Muckley
6510 Gary Sagerman
6520 Edwin Procasky

Design of Research Analysis Center, Bldg. 142 Addition
1301 Arthur Brenza
1301 William Crell, Jr.
3370 Juanita Williams
7610 Gene Pinali
7610 Mark Woodling
7620 Matthew Brejer
7630 Annette Bhatia
7630 Dallas Lauderdale, Jr.
7630 Ovat Senivong
7630 Ronald Zurawski
7650 Donald Cooksey
Robin Nemeth
Robin Prestien

CE-18 Garrett 8.1 Centrifugal Compressor Building & Testing Team
7230 James Densham
7230 Rhonda Holstein
7230 Charles Martin
7230 Robert Sorg
7230 Alan Studnicka

Hiss Tanker Test Program Crew
7205 William Bohrer
7205 Regina Kelly
7205 Eiter Reyes

10 by 10 Supersonic Wind Tunnel Team
7240 Leonard Bellisario
7240 Mark Bodziony
7240 George Brutcher
7240 Richard Fry, Sr.
7240 Robert Gray, II
7240 Richard Herrlich
7240 Halbert Hoyett
7240 George Jacynycz
7240 Gregory Kelbach, Jr.
7240 William Korhely
7240 Daniel Kovach, Jr.
7240 Michael Lee
7240 Willie Minor
7240 Andrew Ostromek, Jr.
7240 Charles Pennington
7240 James Quinones
7240 Charles Richter
7240 Dennis Veverka
7240 Frank Zelko
7300 William Stokes, Jr.

9 by 15 Low Speed Wind Tunnel Team
7240 John Bonham
7240 Donald Costello
7240 James Coy
7240 Dennis Fischbach
7240 Dale Houghtlen
7240 Michael Robertson
7240 Richard Spangle
7240 John Urban, Jr.
7240 Dale Wolfe
7240 Kenneth Zaremba
7260 Curtis Carl

Flight Test Team for Convective Heat Transfer Experiment
7205 Dale Garrett
7205 Mary Ann Lupica
7205 Preston Stamper
7205 Richard Tabar

8 by 6 Supersonic Wind Tunnel Team
7240 James Braatz
7240 Robert Bickford
7240 Edward Gordon
7240 James Jackson
7240 Richard Speer
7240 Donald Szalkowski
7240 Christian Wisbar
7240 Wendell White
7260 Thomas Marino, Jr.
7260 William Ratvasky

Icing Research Tunnel Support Team
7210 Lawrence Csanyi
7210 Jack Cuthrell
7210 David Justavick, Jr.
7210 Michael Lupton
7210 David Masters
7210 Jerals Pamer
7210 William Parker, Jr.
7210 William Sexton, Jr.
7210 Ronald Smith

Microelectronics Laboratory Team
7260 Donna Bohman
7260 Charles Hulbert, Jr.
7260 Nicholas Varaljay

J-85 2DCD Nozzle Support Team
7210 Eric Miller
7210 James Nicholas
7210 Dominic Ruccella
7210 Jack Schuerger
7210 Timothy Shaltens
7210 Kent Smith
7210 William Spilker
7430 William Furst

Dynamatron Accelerator Transference Team
7280 Damaso Aponte, Jr.
7280 Charles Boros
7280 Gregory Buchar
7280 Heriberto Medina
7280 George Pindroh

Augmentor Test Rig Buildup & Testing Team
7220 Richard Dudash
7220 Richard Hudnell
7220 Kevin Fischer
7220 Charles Stauffer
7220 Stephen Grozner
7220 Gregory Hill
7220 Jeffrey Paulin
7430 John Brodkowski

Enroute Noise Experiment—Lear/PTA Aircraft Team
7205 John Johnson
7205 Donald Rhodes
7460 Michael Lelak, Jr.
7460 William Prochazka

Large Low Speed Centrifugal Compressor Facility Buildup Team
7220 Jack Chargo
7220 Vincent Conrad
7220 Robert Lee Davis
7220 Michael Goin
7220 Albert Sbeghan
7220 Bruce Wright

MMSL Safety Team
5110 Henry deGroh
7280 Wayne Gardner
7280 Louis Sater

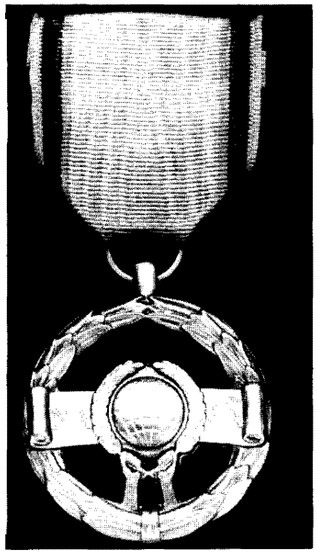
Control Sensor Failure Accomodation Validation Team
0140 Steven Kroszkewicz
2550 John DeLaat
2550 Walter Merrill
2820 Mahmood Abdelwahab
2820 Thomas Kirchgessner
2820 Robert Solomon
2850 John Moss, Jr.

CONTINUED ON PAGE 4

1990 Honor Awards Recipients

DISTINGUISHED SERVICE MEDAL: *John M. Klineberg*, director of LeRC, for technical direction and leadership of research and technology programs.

EXCEPTIONAL SERVICE MEDAL: *Kenny E. Aguilar*, deputy chief of Human Resources Management Division; *Armen S. Asadourian*, deputy chief of the Instrumentation and Data Systems Branch; *Gerald J.*



EXCEPTIONAL SERVICE MEDAL

Barna, deputy of Integration of the Center's Space Station Freedom Directorate and chief of the Systems Engineering and Integration Divisions; *Peter G. Batterton*, chief of the Supersonics and Powered Lift Branch; *Kenneth W. Baud*, aerospace engineer serving as a technical advisor to the chief of the Launch Vehicle Project Office; *Thomas H. Cochran*, deputy director of the Space Station Freedom Directorate; *James H. Diedrich*, chief of Aerodynamics, Icing, and Flight Branch; *Richard T. Gedney*, manager of the Advanced Communications Technology Satellite (ACTS) Project Office; *Howard D. Jackson*, heading Advanced Communications Technology Satellite (ACTS); *Richard B. Lancashire*, Mission Assessment and Applications Branch; *Carl F. Lorenzo*, Advanced Control Technology Branch; *Carl E. Lowell*, deputy chief of the Materials Division; *William J. Middendorf*, chief of the Electronic and Control Systems Division; *Harold E. Neustadter*, chief of the Information Systems Service Branch in the Operations Division; *George A. Pinkas*, chief of the Structural Systems Branch; *James R. Ramler*, chief of the Space Electronics Division; *Joseph A. Saggio*, Comptroller of Lewis Research Center; *Jack A. Salzmann*, chief of the Microgravity Science and Technology Branch of the Space Experiments Division; *Francis J. Shaker*, deputy chief of the Structural Systems Dynamics Branch; *Robert J. Shaw*, deputy chief for Applied Aerodynamics, Propulsion Systems Division.

EXCEPTIONAL ENGINEERING ACHIEVEMENT MEDAL: *Thomas J. Benson*, deputy chief of the Computational Methods Branch; *Lawrence J. Bober*, deputy chief of the Propeller and Acoustics Technology Branch; *Rodrick V. Chima*, acting head of the Turbomachinery Technology Branch; *Irving G. Hansen*, Power Technology Division, Electrical Components and Systems Branch; *Theodore W. Porada*, Electronic and Control Systems; *Erwin V. Zaretsky*, Structures Division.

EXCEPTIONAL SCIENTIFIC ACHIEVEMENT MEDAL: *J. Anthony Powell*, Engine Sensor Technology Branch, for pioneering research and innovation in the development of silicon carbide.

OUTSTANDING LEADERSHIP MEDAL: *David C. Byers*, Space Propulsion Technology Division, Low Thrust Propulsion Branch, for leadership in low-thrust propulsion technology; *J. Stuart Fordyce*, director of Aerospace Technology, for management in the Aerospace Technology Directorate; *Omer F. Spurlock*, Advanced Space Analysis Office, Systems Analysis Branch chief, for identifying, recruiting, and developing high-caliber, professional engineers; *Steven V. Szabo, Jr.*, director of the Engineering Directorate, for organizing and managing the Engineering Directorate.

GROUP ACHIEVEMENT AWARD: Presented in recognition of outstanding management, superior technical expertise, and exemplary NASA teamwork in the design, development, and operation of the Atlas/Centaur launch vehicle and the recent successful launch of the Navy FLTSATCOM-8 communications satellite on the last NASA managed Atlas/Centaur vehicle AC-68.

John Gibb, Atlas/Centaur project manager, led the team which included: *Kenneth Adams, John Andrasik, Everett Armentrout, Bradley Baker, Thomas Banus, Kathleen Batke, Kenneth Baud, Duane Beach, Wilhelm Benz, Timothy Best, Earl Bloam, Gary Bollenbacher, Donald Brasted Jr., John Brett, Thomas Burke, Mario Castro-Cedeno, William Cobo, Russel Corso, James Couch, Kenneth DeLaat, Augustine Delaney, Annie Easley, Robert Edwards, David Evans, Ronald Everett, Walter Fenning, Richard Flage, Wilson Ford, Randall Furnas, Lawrence Gentile, Gary Golinski, Theresa Goodwin, Scott Graham, Vincent Grebe, Frank Greco, William Groesbeck, Klaus Gumto, Nancy Horton, Rudolph Inglesias, Rill Ingle, Robert Jabo, Thomas Jentner, Richard Kalo, Harold Kasper, Michael Kinkelaar, Martin Kisel Jr., William Klein, John Klineberg, Paul Kuebeler, Ralph Kuivinen, Raymond Lacovic, Vincent Lalli, Raymond Lacovic, Vincent Lalli, Raymond Lark, Kuan Lee, Michael Makinen, William Mason, James McAleese, Robert Metroka, William Middendorf, Robert Miller, Theodore Mockler, Carl Monnin, Edwin Muckley, Thomas Niezgoda, Donald Noga, Cecil O'Dear, Richard Oeftering, Richard Orzechowski, Donald Perdue, Clarence Pierce, David Plachta, Edwin Procasky, Debra Rak, John Reagan, David Repas, William Rice, Jean Rogers, Robet Robal, Dennis Rohn, Francis Rooker, Lawrence Ross, Harold Sample, Rafael Sanabria, Noel Sargent, Lois Scaglione, George Schaefer, Eugene Schiopota, William Schoren, Margaret Schuler, Thomas Seeholzer, Karen Sherman, Jack Shinn, Michael Skor, Robert Smith Jr., Gerald Snyder, Isadore Sonkin, Earl Sprague, Cynthia Stepka, Margie Studley, Steven Szabo Jr., Andrew Szaniszlo, Thomas Tokmenko, Dennis Vanco, Mary Kay Varholick, Vernon Weyers, Ulrich Wiedenmannott, Lynne Wiersma, Stephen Wiersma, Joseph Wikete.*

"It's the people who make things happen. It is you folks here today that are the kind of people that make NASA tck,"—NASA Deputy Administrator J.R. Thompson.

EXCEPTIONAL SCIENTIFIC MEDAL

EXCEPTIONAL ENGINEERING MEDAL

DISTINGUISHED PUBLICATION AWARD: *Khairul Zaman, Daniel J. McKinzie, Chiristopher L. Rumsey*, in recognition of their publication "A Natural Low-Frequency Oscillation of the Flow Over an Airfoil Near Stalling Conditions."

FIFTY-YEAR SERVICE EMBLEM; *C. Robert Morse*, Operations Engineer, Aeropropulsion Facilities and Experiments Division.

FORTY-FIVE-YEAR SERVICE EMBLEM: *Richard H. Cavicchi*, aerospace engineer, Internal Fluid Mechanics Division; *Roger W. Luidens*, aerospace engineer, Aeroprpulsion Analysis Office.

EXCEPTIONAL LEADERSHIP MEDAL

FORTY-YEAR SERVICE EMBLEM: *Robert W. Graham*, chief of Technology Assessment Office, Office of Interagency and Industry Programs; *Arthur E. Sprungle*, mechanical engineering Technician, Propulsion and Fluid Systems Division.

Special Achievement Awards

Special Achievement Awards are lump-sum cash awards given for Sustained Superior Performance, Special Act, or Group Achievement. The following people are recognized for their contributions during the second half of 1990.

SUSTAINED SUPERIOR PERFORMANCE AWARDS
0110 Nancy A. Horansky
0131 Reda R. Mankbadi
0151 Frank J. Barina
0151 Karl F. Reader
1013 Mary C. Kovach
1130 Linda R. Penczak
1140 Patricia A. Zamaria
1900 Nancy M. Wolf
2650 James D. Holdeman
5100 Sandra K. Giorgio
5230 Marjorie M. Trujillo
5310 Diane M. Billik
5420 Paul R. Prokopius
5490 Thaddeus S. Mroz
7010 Lauren M. Yost
7202 Robert O. Brown
7202 Howard F. Kilpatrick, Jr.
7230 Thomas P. Dorony
7240 John R. Rhyner
7240 Frank A. Zelko
7260 Gordon H. Driver
7311 Gregory W. Schade
7311 Erich Gottl
7331 Norman A. Arnold
7331 Albert B. Matthews, Jr.
7440 Eric W. Faykus
8110 Janice K. Gassaway
8110 Debra J. DeAngelo
8510 David J. Hoffman
8520 Dorelia Y. Sharp
8530 Gary Kelm
8540 Linda J. Bartos
8600 Anne M. Teubl
8810 Richard A. Edkin
8830 Jack C. Kovacs
8910 Thomas E. Vasek

SPECIAL ACT OR SERVICE AWARD
0112 Patricia J. Yacobucci
0112 Phillip L. Stone
0120 Kent N. Stone
0120 Clyde E. Bailey
0120 James A. Mackin
0150 Linda M. McAllister
0151 Richard W. Heath, Jr.
0151 Kimlan T. Pham
0151 Henrikas V. Bankaitis
0152 Margaret M. Schuler
0152 Vincent R. Lalli
0153 Daniel P. Morilak
0170 Barbara A. Perkowski
0170 David D. Renz
0180 Judy Montfort
0190 Georgia M. Reynolds
1012 Richard L. Reames
1100 Carmela Bogdan
1310 Linda S. Little
1330 Elizabeth S. Oravec
1350 Darryl J. Klag
1360 Jerome E. Rodak
1390 Grissellle LaFontaine
1390 Fredric Goldberg
2630 Louis M. Russell
2670 Thomas J. Benson
2670 Diane B. Kovach
2700 Mary Y. Tharp
2700 Gloria J. Richards
2701 David A. Sagerser
2720 Mary L. Dietz
2740 Darcie M. Hammer
2740 Mary Jo Long
2750 Kaleel L. Abdalla
2750 Barbara S. Esker
2780 James T. Walton
2840 James T. Bowser
2850 Mark R. Woike
2870 Robert Ziemke
3230 Duane E. Schaft
3320 Mary J. Bailey
3330 Debra A. Rak
4120 Richard C. Oeftering
4130 Carl J. Wenzler
4110 David W. Liebal
4110 Jeffrey C. Brown
4110 William K. Coho
4110 William D. Espinosa
4110 Lois J. Scaglione
4120 Michael J. Lewis
4210 Gerald A. Carek
4220 Robert J. Buehrle
4220 Alvin C. Hahn
4230 Patrick W. Dunn
4230 Raymond F. Lacovic
4230 Derrick J. Cheston
4310 Khan S. Lee
4310 Robert P. Miller
4320 Michael A. Ernst
4320 Vithal Dalsania
4330 Richard T. Barrett
4410 Paul A. Harlamert
4430 Arthur E. Sprungle
5100 Hubert B. Probst
5170 David R. Hull
5170 Frances A. Archer
5200 Cynthia S. Szanca
5210 Dale A. Hopkins
5220 Frederic A. Holland, Jr.
5230 Anatole P. Kurkov
5230 Oral Mehmed
5230 Gerald V. Brown
5250 Edward R. Generazio
5300 Sandra B. Foust
5320 John M. Kazaroff
5320 William K. Tabata
5330 Michael J. Patterson
5400 Elaine R. Quayle
5420 Randy Gahn
5460 Richard K. Shaltens
5620 Edwin G. Wintucky
6130 Don R. Hilderman
6200 David M. DeFelice
6220 Edward H. Kramer
6730 William M. Foster II
6770 Nancy J. Shaw
6800 Patricia A. Lewis
6800 Marisa Pischel
6810 John S. Clark
6810 Stephanie J. Black
6810 Steven M. Stevenson
6810 William A. Poley
6820 Sandra Hippensteele
7010 James Afarin
7210 Michael W. Lupton
7230 Thomas J. Toddy
7230 William G. Darby
7230 John J. Ropchock
7230 Robert C. Olsey
7230 Robert L. Davis
7240 Richard M. Herrlich
7250 Peter F. Klein
7250 Gerald M. Hill
7250 Charles J. Gestrich
7280 Robert W. Coughlin
7400 Dennis G. Raible
7410 John P. Pokatello
7430 Perry A. Cardwell, Jr.
7430 John Koch, Jr.
7450 Daniel V. Gura
7450 Michael C. Thompson
8530 Timothy E. Tyburski
8610 Kenneth A. Burke
8630 Thomas B. Miller
8630 David T. Frate
8820 Adolph C. Spagnuolo
8830 Karen M. Meinert

GROUP ACHIEVEMENT AWARDS

STUDIO REHAB TEAM
1930 Laura M. Bagnell
1930 Howard A. Slater
7010 James Afarin
7360 Migual Rivera, Jr.
CRTZ Angela M. Coyne
CRTZ Quentin L. Schwinn
CRTZ Marvin Smith
CRTZ Jay C. Owens

C OF F ADVOCACY GROUP
5100 Carl E. Lowell
5120 John Gayda
5150 Gary D. Roberts
5170 Robert L. Davies
5170 Serene C. Farmer
5170 Dereck F. Johnson
5200 Peter T. Bizon
5250 Edward R. Generazio
CRTZ Linda Oliver
SVER Jeff Eldridge

CHEMICAL SAMPLING & ANALYSIS OFFICE TEAM
7025 Priscilla A. Mobley
7025 Renee J. Batts
7025 Joseph A. Mills
7025 Reginald H. Duncan

PHASE II HOT GAS INGESTION TEAM
7240 James H. Jackson

RL-11 RAYLEIGH SCATTERING EXPERIMENT FOR H202 ROCKET PLUME DIAGNOSTICS
2520 Richard G. Seasholtz
5330 Brian D. Reed
5330 Frank J. Zupanc
5330 Steven J. Schneider
SVER Andrew P. Kremer
SVER Lynn A. Arrington

8×6/9×15 FLOW QUALITY STUDY TIME
0300 Lawrence F. Schumann
2000 Jeffrey M. Donbar
2640 Eric R. McFarland
2770 Laurence J. Heidelberg
2780 Richard R. Burley
2780 Donald R. Boldman
2830 Mark T. Pickett
2850 Timothy J. Bencic
2640 Jerry R. Wood
2660 Khairul Zaman
2660 Edward J. Rice
2760 Frederick A. Newman
2780 Danny P. Hwang
2810 Osvaldo Rivera
2830 Kirk D. Seablom
SVER James Schmidt
SVER Kurt H. Loos
SVER E. Allen Arrington

HIGH TEMPERATURE 6H SILICON CARBIDE MOSFET GROUP
2540 Lawrence G. Matus
2540 J. Anthony Powell
CALS Carl. S. Salupo
SVER Jeremy B. Petit

AIR FORCE/NASA LOW POWER ICE PROTECTION TEAM
1930 Howard Slater
2720 Jaiwon Shin
2720 Thomas H. Bond
2810 David W. Vincent
2830 David W. Sheldon
2850 Charles R. Andracchio
2850 Robert J. Freedman
A.F. Clifford M. Gyves
CRTZ Jay C. Owens

COUNSEL OFFICE INTEGRATION TEAM
0120 Mildred C. Hutchison
0120 Janis B. Cimber
0120 Bernatte M. Baldwin

LEWIS LITIGATION TEAM
0120 Robert E. Freed
0120 Jerald J. Kennemuth

LERC SECRETARIAL GUIDE TEAM
0100 Monica M. Palivoda
2700 Janet M. Cox
2770 Marcia Y. Bellamy
3310 Sonia M. Schriver
5000 Mary Anne Mulroy
5300 Jody C. Getz
5320 Grace E. Jennings
6100 Deborah A. Cotleur
6200 Kimberly A. Dalgleish
6500 Lynne M. Wiersma
6700 Sandra B. Duhr
6770 Michelle L. S. Oriold

T-34 EDUCATIONAL PROJECT
1021 Marc Horn
1930 Howard Slater
2860 William Rieke
5490 Karl Baker
7205 Donald G. Rhodes
7460 William Prochazka
CRTZ Jay Owens
MSI Frederick C. Lemieux
MSI Edward Blickenstaff
MSI William Bohrer
MSI Jeffrey Cook
MSI Carl McLucas

FTS 2000 IMPLEMENTATION TEAM
1390 Mike Heryak
1390 Phyllis Geffert
1390 Roger Schulte
FBS Ernie Cox
FBS Jerome Moore
FBS Bob Hayes
BOEG Joe McMillen
BOEG James Malloy
BOEG Edward Kwasny
BOEG Tim Taylor
AT&T Price Howard
SVER Bob DiTirro

8X6/9X15 FLOW QUALITY STUDY TEAM
1330 Gerald J. Lenhart
1330 Susan L. Button
1330 Troy Hauser
1330 Violet A. Minchak

TRADAR-3 SYSTEM TEAM
1360 Richard Fulton
1360 William Loftus
1360 James Stachiw
1370 Donald Braun
1370 Les Farkas
SVER Omar Syed

SCIENTIFIC VAX CLUSTER AUGMENTATION TEAM
1370 Robert Kannenberg
1370 Dennis Kay
1370 Steve Prahst
1370 Joseph Rossoll
SVER Greg Blumers
SVER Kathy Price
BNDX Joseph Fronek

OUTSTANDING MAINTENANCE OF THE LEWIS INFORMATION NETWORK (LINK)
1390 Juan Rivera
1390 Joe Maziarz
SVER Ray Sefchik
SVER Bill Burkett
SVER John Zajacz

CE-22 FACILITY CAPABILITY ENHANCEMENT AND PRODUCTIVITY IMPROVEMENT TEAM
2820 Luis R. Beltran
2850 Benjamin J. Dastoli
2850 Richard L. Del Roso
7230 John E. Cotter
7230 Larry A. Jones

HSR LOW NOx LEAN PREMIXED/PREVAPORIZED (LPP) RESEARCH TEAM
0300 Waldo Acosta
1330 Ronald Abel
2710 Robert Tacina
2710 Yolanda Hicks
2710 Lee Nguyen
2710 Chi Ming Lee
2710 Kue Chun
2710 Jim Rohlbuhler
2710 Paul Kang
2840 Eric Gustke
2850 John Leone
4220 Robert J. Buehrle
5130 Dennis Fox
5160 Nate Jacobson
5160 Leslie Greenbauer-Seng
7230 Jerald Beal
7230 Wade Arida
7230 Dennis Kinzelman
SVER Dean Kocan
SVER Dave Hulligan

IRT USERS MANUAL TEAM
2830 Ronald H. Soeder
2850 Charles R. Andracchio

AFED TEAM BUILDING/ GRAPHICS GROUP
2810 James J. Lavelle
2870 Harry E. McCune

CASH IMPLEMENTATION TEAM
1012 Carole Demongeot
1340 Melva Schwartz
1340 Thomas Finnegan
3200 Terry Whaley
3210 Joe Kran
3220 Yolanda Rivera
3220 John Morley
3220 Cheri Seiler
3220 Debbie McCafferty
CRTZ Kathy Wargo
CRTZ Joan Tysiak
SVER Randy Zak
SVER Karl Bloss
SVER Wilma Graham
SVER Eric Schultz
SVER Howard Frederick
ANLX Sam Spero

PURCHASING TEAM
3380 Kiska Sifers
3380 Eileen Lavelle
3380 Konrad Mader
3380 June Szucs
3380 Florence Shiner
3380 Doreen Halstead
3380 Kathy Webb
3380 Maryann Dutkofski
3380 Dennis Pehotsky
3380 Cherie Washam
3380 Rita M. Turske

PROCUREMENT SUPPORT TO THE PURCHASE BRANCH & ADP & EQUIPMENT BRANCH
3340 Mary Lou Herrmann
3370 Jean Rogers
3370 Juanita Williams
3370 Deborah Drossis
3370 Michael Kinkelaar
3370 Thomas Spicer
3370 Erick Lupson
3370 Angel Pagan

ENGINEERING DIRECTORATE MANAGEMENT INFORMATION SYSTEM DEVELOPMENT TEAM
4220 Alex L. Pucci
ANLX Gayle A. Kavalec
SVER Luanna R. Katz
SVER Christine A. Baldassari

SOLID SURFACE COMBUSTION EXPERIMENT
6220 Daniel M. Vento
6730 Neil D. Rowe
6730 John M. Koudelka
6730 William M. Foster II
6740 Sandra L. Olson
6740 Kurt R. Sacksteder
6750 Ralph J. Zavesky
6750 Louis R. Ignaczak
6750 Angel M. Otero
6750 Michael H. Brace
6760 Poppy Kalis

SPACE ACCELERATION MEASUREMENT SYSTEM
2870 Theodore Chase
6730 Neil D. Rowe
6730 John M. Koudelka
6730 Clifford E. Siegert
6730 Richard DeLombard

Continued on page 4

Volume 30 Issue 24 December 3, 1993

Scientists discover silicon carbide crystal growth process

LEWIS scientists announced a major advancement in a rapidly emerging semiconductor technology at the recent International Conference on Silicon Carbide and Related Materials in Washington, D.C.

Dr. David J. Larkin, Instrumentation and Control Technology Division, and his Lewis teammates have developed a new silicon carbide crystal growth process, called "site competition epitaxy," which they presented at the conference.

"This new growth process can be used to produce superior silicon carbide semiconductor electronic devices. Silicon carbide electronic devices can withstand temperatures of 1200 degrees Fahrenheit, much higher than conventional semiconductors. This will enable electric systems to replace cumbersome hydraulic and pneumatic systems now used in jet engines that will result in cleaner, more fuel-efficient aircraft," Larkin said.

Silicon carbide electronics also offer significant performance gains for spacecraft, electric vehicles, microwave radar, cellular communications systems, and computer memories.

High voltage diodes (diodes are fundamental components of most circuits) have been produced by the group using the semiconductor technology. These diodes successfully operated at 2000 volts, the highest voltages ever recorded for devices using silicon carbide.

Under the sponsorship of NASA's Office of Aeronautics, Lewis has been a major participant in silicon carbide electronics development work for the last decade. Larkin's colleagues in this research are Dr. Philip G. Neudeck, J. Anthony Powell, and Dr. Lawrence G. Matus. The group works in the High Temperature Integrated Electronics and Sensors program at Lewis. ◆

—Linda Ellis
Media Relations Specialist

Twenty-two employees recognized for inventions

TWENTY-two Lewis employees and their inventions were recognized during Lewis' Nineteenth Annual Inventors' Day Luncheon and Ceremony on May 18, 1994.

Patents are a valuable component of Lewis' inventory of intellectual property. The documentation of these innovations through patents are important to the Center for a number of reasons: patents are one of the devices that enable us to maintain control over the end products of our research—ensuring our ability to build upon our technological advances and maintain a continuing influence on future development in those technical fields of interest to us, patents provide return on our investment in research—allowing us to leverage the value of that research by licensing it for commercial development, and patents, as part of our intellectual property inventory, and enhance the professional stature both of the Center and of our researchers.

Patents are one of the devices that enable us to maintain control over the end products of our research—ensuring our ability to build upon our technological advances today and in the future.

The patents and their inventors recognized during the ceremony include: *Multi-Heat Addition Turbine Engine* by Leo Franciscus, Mission Analysis Branch, and Theodore Brabbs, Sverdrup; *Spectroscopic Wear Detector* by George Madzsar, Launch Vehicle Propulsion Branch; *Alkali Metal Carbon Dioxide Electrochemical System for Energy Storage and/or Conversion of Carbon Dioxide to Oxygen* by Norman Hagedorn, Electrochemical Technology Branch; *Ceramic Reinforced Glass-Ceramic Matrix Composite* by Narottam Bansal, Ceramics Branch; *Semiconductor Cooling Apparatus* by James Gaier, Electro-Physics Branch; *Apparatus for Intercalating Large Quantities of Fibrous Structures* by James Gaier, Electro-Physics Branch; *Method of Reducing Drag in Aerodynamic Systems* by Frank Hrach, Systems Integration Branch; *Three Point Lead Screw Positioning Apparatus for a Cavity Tuning Plate, ADF, Self-Deploying Photovoltaic Power System* by Anthony Colozza, Power Systems Integration Office; *Process for the Homoepitaxial Growth of Single-Crystal Silicon Carbide Films on Silicon Carbide Wafers* by J. Anthony Powell, Engine Sensor Technology Branch; *Consecutive Plate Acoustic Suppressor Apparatus and Methods* by Joseph Doychak, Enabling Propulsion Materials Project Office, and Tony Parrott, Langley Research Center; *Guanidine Based Vehicle/ Binders for Use With Oxides, Metals and Ceramics* by Martha Jaskowiak, Ceramics Branch; *Sintering Silicon Nitride* by Narottam Bansal and Stanley Levine, Ceramics Branch, and William Sanders, Analex; *Intercalated Hybrid Graphite Fiber Composite* by James Gaier, Electro-Physics Branch; and *System and Method for Canceling Expansion Waves in a Wave Rotor* by Daniel Paxson, Systems Dynamics Branch. ◆

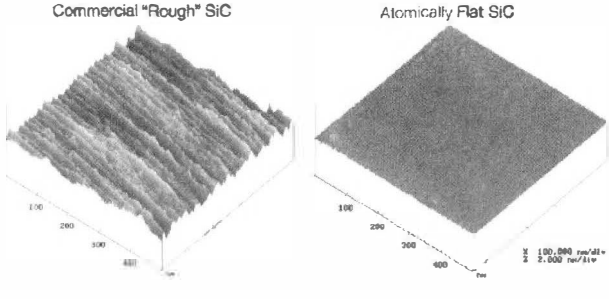
NASA GLENN RESEARCH CENTER
AEROSPACE Frontiers
VOLUME 3 ISSUE 5 MAY 2001

Glenn researchers patent method for step-free semiconductor surfaces

BY PAM CASWELL

RESEARCHERS in the Sensors and Electronics Technology Branch have received a second patent for their method of growing atomically flat surfaces, without a single step even one atom high, on commercial semiconductor wafers. The step-free surfaces hold particular promise for improving the performance and reliability of a new class of microelectronic devices that could be used in

CONTINUED ON PAGE 10



Graphic (below, left) compares a commercial rough silicon carbide (SiC) film surface with an atomically flat step-free SiC film surface grown by the newly developed Glenn process. These surface images were obtained with an atomic force microscope.

INSIDE

Second patent awarded

Applications range from DVDs to jet engines

CONTINUED FROM PAGE 1

everything from DVDs to jet engines.

Commercial semiconductor wafers are covered with steps, typically one to eight atoms high, despite careful polishing by their manufacturers. The research team makes step-free surfaces by first etching device-sized arrays of mesas (named for the geologic formations) into the wafers. Next, by controlling conditions, the researchers limit crystal growth to the riser, or side, of each atomic step. The crystal at each step grows sideways until the step reaches the edge of the mesa, leaving behind an atomically flat surface.

"We've flattened silicon carbide mesas as large as 0.4 by 0.4 millimeter and, depending on the mesas' size, over half of the mesas on a wafer," said Tony Powell, Sensors and Electronics Technology Branch. "What's so attractive about our method is that, with just one extra patterning step in the fabrication, manufacturers can make these step-free surfaces."

Those mesas that were not made flat contained screw dislocation defects —so called because of the warped spiral stacking of the crystalline planes—which are not amenable to this flattening method. An addedt benefit of the method is that itt isolates the screw defects into mesast that can be identified and avoided.t

Studies by other scientists have linked surface steps in the wafer to defects in semiconductor films that are different from the wafer material. The defects cause poor performance and reliability and have been troublesome to the development of new electronics for aerospace applications.

"We believe that step-free surfaces will enable remarkable improvements in devices based on silicon carbide and gallium nitride. These are the materials of choice for making high-power, solid-state switches as well as electronics for hostile environments, such as pollution and noise control devices inside aircraft engines," Powell said.

Industry researchers are using these materials for blue light emitting diodes (LEDs) for lighting, blue lasers for higher capacity DVDs, and high efficiency transistors for more reliable electrical power switching and improved wireless communications.

Glenn co-inventors Powell, Dr. David Larkin, Dr. Phil Neudeck, and Dr. Larry Matus are working with the Commercial Technology Office and GLITeC to transfer this technology via patent licensing opportunities. The Branch conducts research on sensors, electronics and microelectronic mechanical systems (MEMS) for harsh environment aerospace applications. ◆

Pam Caswell is a public affairs specialist in the Community and Media Relations Office.

2002 Honor Awards

Continued from page 1

crystal growth in the presence and absence of gravity.

Nancy Rabel Hall: For exceptional and exemplary contributions in educational outreach.

David L. Krause: For outstanding leadership and creativity in the development of innovative methods to evaluate structural fabric materials and derived structures for NASA and Department of Defense applications.

Thomas M. Lavelle: For successful development and transfer of propulsion systems simulation to industry as engineering lead of the Numerical Propulsion Systems Simulation Production Team.

Diane L. Linne: For numerous technical achievements as well as shaping the technical strategy and approach of many space transportation programs.

Charles K. Smalley: For outstanding efforts over the last 9 years in the training of interns, cooperative students, and apprentices from a variety of trades as well as welfare-to-work people as machinists.

Don J. Sosoka: For significant contributions to the implementation of the Outsourcing Desktop Initiative for NASA (ODIN), one of the first large Federal initiatives to privatize the desktop environment.

★ *Exceptional Service Medal*

Dr. Kul B. Bhasin: For outstanding technology and programmatic management for the NASA Glenn Research Center Space Communications Program.

Dr. Isaiah M. Blankson: For outstanding contributions to developing technologies for high-speed flight.

Dr. Raymond K. Burns: For outstanding power technology management efforts at Glenn Research Center.

Terry L. Ferrier: For exceptional service in the areas of thermoelectric instrumentation and microelectromechanical systems that contribute significantly to the efficiency and success of NASA Glenn Research Center projects.

Dennis L. Huff: For leading NASA's engine noise reduction programs over the past 10 years, which has resulted in technologies that are being used to design next-generation turbofans.

Dr. Lennart S. Hultgren: For theoretical contributions in the area of transition, receptivity, and unsteady flow physics, leading to better models for engineering applications.

Helen J. Kabak: For exceptional secretarial leadership, professionalism, and dedication that are indispensable to the Glenn Research Center and to the operation of its largest and most diverse Directorate, Engineering and Technical Services.

J. Anthony Powell: For exceptional accomplishment and leadership in performing pioneering research to develop silicon-carbide as a high-temperature semiconductor material.

Dr. Steven M. Sidik: For exceptional service in bringing major computational services to the NASA Glenn Research Center.

Dr. Bhim S. Singh: For outstanding technical and managerial leadership, which has enabled significant enhancements in the breadth, status, and value of the Microgravity Fluid Physics Program.

Marjorie M. Trujillo: For outstanding contributions to the operation of the Research and Technology Directorate at the NASA Glenn Research Center.

Dr. Kim A. Veris: For continuous and dedicated service to the Agency and the Glenn Research Center's technology transfer and resource management objectives.

Robert J. Zakrajsek: For his unique contributions and exceptional ability to conceptualize, design, and integrate high-level successful demonstrations of communications technology for a variety of launch vehicles and spacecraft in support of NASA missions.

★ *Exceptional Engineering Achievement Medal*

Dr. Rebecca A. MacKay: For outstanding materials engineering achievements for the aerospace propulsion community.

Claudia M. Meyer: For pioneering the development of advanced diagnostics technologies and their application to propulsion health management for space transportation systems.

David W. Plachta: For significant technical contributions to NASA's goal of safe and affordable access to space.

Dr. Steven J. Schneider: For significant engineering contributions toward the achievement of high-performance chemical propulsion for NASA's planetary science missions with the development of high-performance iridium-coated rhenium rocket technology.

★ *Equal Employment Opportunity Medal*

Dr. Michael A. Meador: For sustained, outstanding mentoring of students and advocacy of research partnerships with Historically Black Colleges and Universities and Other Minority Universities.

★ *Public Service Medal*

Paul R. McMasters: For outstanding and exemplary support of the Space Communications Office business activities and continuous efforts to improve their quality.

Hee-Mann Yun: For significant contributions toward development of silicon-carbide fiber and its application to ceramic matrix composites for aerospace application.

★ *Group Achievement Awards*

Traveling Wave Tube Amplifier Team: For exemplary performance in solving the many technical problems in the traveling wave tube amplifier design, which

Innovative Technologies Earn NASA Glenn Three R&D 100 Award

Three innovations developed at NASA's Glenn Research Center, Cleveland, were among the top 100 most technologically significant products introduced into the marketplace over the past year, according to an independent judging panel and the editors of R&D Magazine. The awards were recognized on October 14 at an event at Chicago's Navy Pier.

The three NASA Glenn innovations are described below.

The ME3 Advanced Turbine Disk Alloy, developed by Glenn materials researchers Michael Nathal, Timothy Gabb and Robert Draper in collaboration with GE Aircraft Engines and Pratt & Whitney engineers, is a nickel-based powder metallurgy superalloy that will withstand high combustion temperatures for improved engine efficiency and help prolong turbine and compressor disk life. By allowing engines to withstand higher combustion temperatures and Pressure ratios, the use of ME3 results in increased fuel efficiency, lower fuel burn and reduced emissions - ME3 is useful for aircraft with longer take-off requirements or high-speed cruise aircraft, such as super jumbo jets, supersonic jet aircraft and advanced military aerospace vehicles. Engine manufacturers can also use ME3 at current operating temperatures to increase the time between required engine maintenance, since it is estimated to last nearly 30 times longer than current disk material.

Named for its inventor, Carlos Morrison of Glenn, the Morrison Motor operates without a bearing and incorporates a switched-reluctance motor with an 8-pole stator and 6-pole rotor. The motor operates with magnetic levitation instead of bearings, making it ideal for applications in which large temperature variations or other extreme conditions exist. Reduced overall power consumption and less mechanical noise and vibration are achieved with a hybrid rotor and half the number of windings. Its compact design and simpler motor control logic, coupled with an infinitely variable torque/levitation load ratio, makes the motor an attractive tool for pharmaceutical centrifuges, compact industrial grinders, milling machines and high-power density motors for aircraft propulsion.

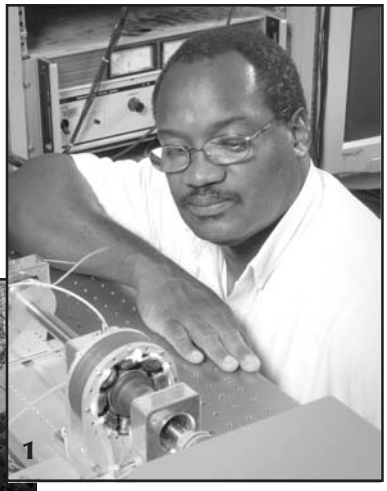
Glenn engineers Phil Abel, Phil Neudeck, Tony Powell and Andy Trunek, in collaboration with Sest, Inc., and OAI, have also developed a diagnostic tool to evaluate and verify the operation and calibration of instruments for measuring nanoscale objects. The Nanometer Step Height Standard (Nanometer SHS) is a calibration standard with arrays of atomic scale staircases. Each staircase features regularly spaced steps nearly 1 micrometer apart with atomically flat terraces between step risers of either 0.5 or 1.0 manometers, as chosen during fabrication. These heights are around 10 times smaller than those of previous standards for scanning probe microscopy calibration. The new devices are fabricated from highly durable single crystal silicon carbide, whose unique crystal properties enable the atomic scale staircase formation. This technology has been patented by NASA and two space act partnerships are in place for commercial application.

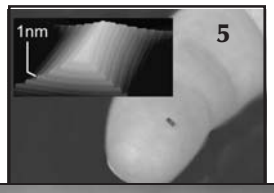
The Reporter, Akron, Ohio, December 11, 2004.

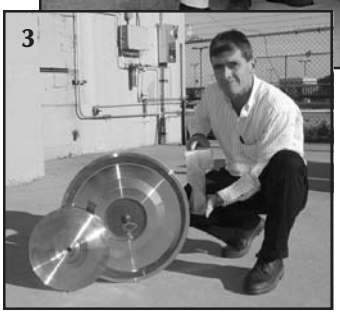
2004 R&D 100 awards

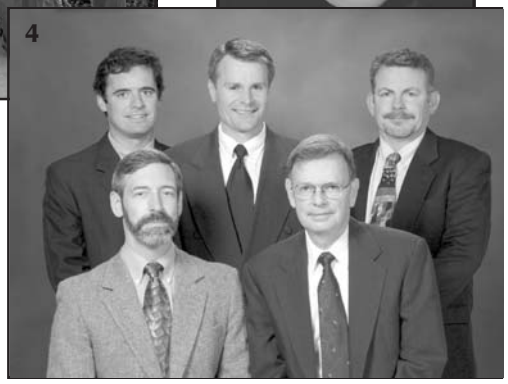
Glenn innovation celebrated among today's top technologies.

Photos by Marvin Smith and Quentin Schwinn









The editors of *R&D Magazine* and a panel of 50 experts chose three Glenn-developed technologies this year to be among the 100 most significant new products to receive the highly coveted R&D 100 Award. Entries in 16 functional categories from many of the most prestigious companies, research organizations, and universities in the world were submitted to the 42nd annual competition and displayed at the R&D 100 Exhibition and Banquet at Chicago's Navy Pier on October 14.

The following Glenn technologies were selected in the categories of materials, electronics/communications, and microscopy.

Glenn materials researchers, in collaboration with engineers from GE Aircraft Engines and Pratt & Whitney, developed the **ME3 Advanced Turbine Disk Alloy**, a nickel-based powder metallurgy superalloy that will not only withstand higher combustion temperatures for improved engine efficiency, but also help prolong the life of turbine and compressor disks. ME3 enables engines to withstand higher combustion temperatures and pressure ratios, translating into increased fuel efficiency, lower fuel burn, and reduced emissions. ME3 is optimized for aircraft with long takeoffs or high-speed cruise missions, such as newly conceived super jumbo jets, high-speed civil transports, supersonic business jets, and several advanced military aerospace vehicles. Engine manufacturers can also use ME3 at current operating temperatures to increase the time between required engine maintenance, since it is estimated to last nearly 30 times longer than current disk material.

Named for its inventor, Carlos Morrison, the **Morrison Motor** is a bearingless switched-reluctance motor with an 8-pole stator and 6-pole rotor. The motor is characterized as bearingless because it operates with magnetic levitation instead of bearings, ideal for applications in which large temperature variations or other extreme conditions exist. The motor employs a hybrid rotor and a stator that contains poles with a single set of windings instead of the two sets used in conventional bearingless motors. This reduces overall power consumption, produces less mechanical noise due to lower rotor eccentricity, and suppresses vibration better than bearing-based motors. Its compact design and simpler motor control logic, coupled with an infinitely variable torque/levitation load ratio, makes the Morrison Motor an attractive tool for use in pharmaceutical centrifuges, compact industrial grinders, milling machines, and high-power density motors for aircraft propulsion.

Glenn engineers, in collaboration with Sest, Inc., and OAI, have also developed a diagnostic tool to evaluate and verify the operation and calibration of instruments for measuring nanoscale objects, as the use of nanotechnology is expected

Continued on next page

Photo captions

(1) Carlos Morrison, Life Prediction Branch, displays his Morrison Motor. (2) The ME3 team, back row, left to right, William Karpinski, QSS, Tim Gabb, David Ellis, and John Gayda, Advanced Metallics Branch. Front, Robert Draper, Vehicle Systems Projects Office; Anita Garg, Advanced Metallics; and Jack Telesman, Life Prediction. Not present are Pete Kantzos, OAI/Life Prediction; Michael Nathalz, Advanced Metallics; Brian Shannon, AKAC; David Mourer and Kenneth Bain, General Electric Aircraft Engine; and Paul Reynolds and Rick Montero, Pratt & Whitney. (3) Draper displays forgings of small and large engine ME3 disks. (4) Back, far left, Peter O'Neill, GLTC/Battelle, joins members of the Nanometer SHS team including Dr. Philip Neudeck and Andrew Trunek, OAI/Sensors and Electronics Branch; and front, Dr. Phillip Abel, Tribology and Surface Science Branch; and J. Anthony Powell, Sest/Sensors and Electronics.

Glenn earns 10 Space Act Awards

Ten Glenn-developed technologies were selected to receive the 2004 NASA Space Act Awards by the NASA Inventions and Contributions Board. Space Act Awards are monetary awards for outstanding scientific or technical contributions sponsored, adopted, supported, or used by NASA that are significant to aeronautics and space activities.

Cockpit Weather Receiver for General Aviation Pilots: Glenn Lindamood and Allen Tucholski (AKAC), Engineering and Technical Services Directorate, and Konstantinos Martzaklis, Programs and Projects Directorate

Planar Particle Imaging Doppler Velocimetry: Mark Wernet, Research and Technology Directorate

Ceramic Composites for High Temperature Engine Components: Dr. Jim DiCarlo, Hee Man Yun (CSU), Gregory Morscher (OAI), and Ramakrishna Bhatt (Army), Research and Technology Directorate

Particle Image Velocimetry Acquisition: Mark Wernet, Research and Technology Directorate

Chemical Equilibrium With Applications: Bonnie McBride and Russ Claus, Research and Technology Directorate, and Dr. Minn Chao, Office of the Chief Information Officer

Morrison Motor: Carlos Morrison, Research and Technology Directorate

Modular Aerospace Propulsion System Simulation: Khary Parker, Dr. Ten-Huei Guo, and Kevin Melcher, Research and Technology Directorate

Affordable Robust Ceramic Joining Technology: Dr. Mrityunjay Singh (QSS), Research and Technology Directorate

Spacesuit Audio System to Enable Robotic Verbal Interaction: Mark Seibert, Research and Technology Directorate

Nanometer Step Height System: Dr. Phil Abel, Dr. Phil Neudeck, Tony Powell (SEST), and Andrew Trunek (OAI), Research and Technology Directorate ◆

Aerospace Frontiers: March 2009

Four members of the Sensors and Electronics Branch, **Dr. Philip Neudeck, David Spry, J. Anthony Powell** (SEST) and **Andrew Trunek** (OAI), have been awarded a U.S. Patent (US 7,449,065 B1) for "Method for the Growth of Large Low-Defect Single Crystals." The patent describes a radically improved process for mass-production growth of wide- bandgap semiconductor crystals, such as silicon carbide, gallium nitride, alumi-num nitride and diamond that promise to enhance electronic performance and reliability for applications involving high-power, high-voltage and/or high-temperature operating conditions.

Awards, Honors and Promotions

NorTech Honors Glenn's Groundbreaking Innovation

A Glenn-developed process that revolutionizes the growth of silicon carbide wafers for the power industry has received a 2012 NorTech Innovation Award. The Northeast Ohio Technology Coalition (NorTech), in partnership with Crain's Cleveland Business, recognized "A Radically New Crystal Growth Concept, Large Tapered Crystal To Achieve Nearly Perfect Silicon Carbide" team during a reception on March 22.

Glenn's Deputy Director Jim Free (far right) congratulates the honorees and their managers. Left to right: Dr. Larry Matus, Ashwin Shah, Trunek, Powell and Neudeck. Not pictured: Spry and Woodworth.

Team members include Phil Neudeck, David Spry and Andrew Trunek (OAI) from the Sensors and Electronics Branch; J.A. Powell of Sest, Inc.; and Andrew Woodworth, a NASA post doctorate fellow.

Glenn's "New High-Temperature Shape Memory Alloys," technology was a finalist in the competition. Michael Nathal, Darrell Gaydosh (OAI) and Anita Garg (University of Toledo), in the Advanced Metallics Branch, developed the shape memory alloys that can act as lightweight actuators in aerospace, automotive and general household applications.

The NorTech Innovation Awards Program is a premier networking event that honors new leading-edge technologies transforming Northeast Ohio's economy.