JANUARY ISSUE 1997

DATELINE LOS ALAMOS

LOS ALAMOS TEAMS WITH INDUSTRY TO DEVELOP FIRST DIAMOND-BASED RADIATION DETECTOR

NEW FAMILY OF HIGH-SPEED, X- AND GAMMA-RAY RADIATION DETECTORS DEMONSTRATE HIGHER PERFORMANCE THAN CONVENTIONAL MODELS

Industry has turned to Los Alamos for help in developing an innovative radiation detector that incorporates a synthetic diamond substrate as an X- and gamma-ray detector. This new class of diamond-based radiation detectors is superior to other types because of its high sensitivity, high-dose-rate detection and total-dose measurement capabilities, and high durability in severe radiation environments.

← Researcher Sung Han holds one of the first microelectronic radiation detectors manufactured using chemical vapor deposition.

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Crystallume, a company based in Santa Clara, Calif., which manufactures products using thin diamond films, and Los Alamos, which has been developing high-dose-rate radiation detectors for more than 10 years, have entered into a cooperative research and development agreement to design and build the new radiation detector.

The new detectors will enable the Department of Energy to improve its radiation monitoring activities for nuclear weapons verification, radiation effects measurement, the new production reactor, inertial confinement fusion, accelerator calibration, and environmental remediation programs.

Los Alamos began its synthetic diamond detector research by investigating the diamond film properties found in other Crystallume products. Under the conditions that natural diamond is formed, the purity of natural diamond crystals varies. But researchers can control diamond film growth, and therefore can control its purity.

Diamond has some inherent properties that are superior to silicon, a material used in most solid-state radiation detectors. Diamond is much more resistant to environmental conditions than silicon. It also is highly resistant to radiation damage as well as relatively unreactive chemically, especially in comparison to silicon. Therefore, diamond detectors can be used in harsh environments, close to high-intensity radiation sources.

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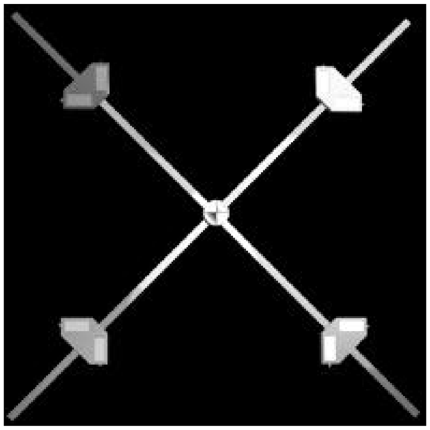
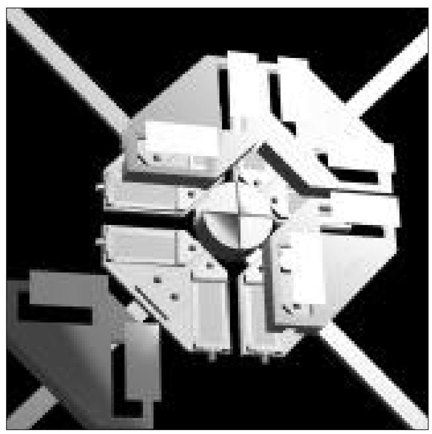
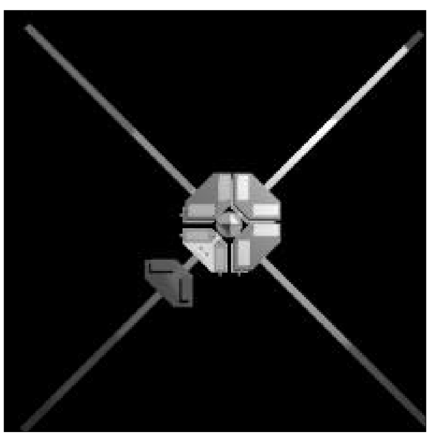


In a harsh radiation environment, diamonds last much longer than silicon — by a factor of 100. Therefore, the amount of time a diamond-based radiation detector operates without failure is 100 times that of a silicon-based radiation detector.

In a harsh radiation environment, a diamond-based detector is more practical and reduces radiation exposure to workers because the amount of time spent calibrating or replacing degraded detectors is greatly reduced.



Until recently, the use of diamond technology for the fabrication of radiation detectors was limited by impurities in both natural and synthetic diamonds and by problems in the fabrication process.



← These 3-D computer images show how the components of the detecting device are pieced together. In the top image, the four components of the device intersect to form an octagon. Each of the four components contains two rectangular-shaped detectors (middle image). The lower image shows the device completely assembled.

Current silicon-based detectors become saturated with radiation at high dose rates, and because testing systems based on silicon are slow, they are not suitable for real-time use at high-dose rates. The diamond-based detector can operate at several times the dose rate that silicon-based radiation detectors can, which makes it suitable for high count rate measurements.

The radiation detector has been tested at a pulse-power facility at Sandia National Laboratories in Albuquerque. The measurement process involves accelerating electrons to a particular energy and then smashing

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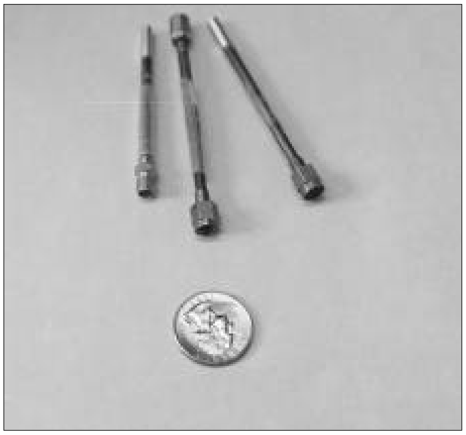
They are not much longer than an adult's thumb. These diamond-based radiation detectors can operate at several times the dose rate that silicon-based radiation detectors can, making them suitable for high-count-rate measurements.



them into a material such as tantalum. The interaction of electrons with the atoms in tantalum, creates an X-ray spectrum. Results derived from the X-ray measurement can be made in less than one day.

Diamond films have numerous applications in the areas of high-performance capacitors, electronic packages for advanced microprocessors, and other microelectronic devices such as microscopes, sensors, and jet engines.

Crystallume manufactures advanced devices coated with synthetic diamond films through a process known as chemical vapor deposition — an advanced materials process used to apply a thin coating of diamond onto another material or substrate.

Most of the high-dose and dose-rate applications are for radiation-producing machines that are federally owned, so the market for these detectors is rather narrow. However, radiation therapy, environmental radiation monitoring, nuclear and atomic physics research, and atomic power generation are just some of the detector's future applications.

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ACCELERATOR PRODUCTION OF TRITIUM WILL BOOST NORTHERN NEW MEXICO ECONOMY

LOS ALAMOS LEADS ACCELERATOR PROJECT TO PROVIDE THE UNITED STATES WITH A RELIABLE SUPPLY OF TRITIUM

Los Alamos expects to pump about $10 million a year for the next five years into the northern New Mexico economy through the accelerator production of tritium. The Department of Energy announced a contract award of about $3 billion to Burns and Roe Enterprises Inc. to design, and possibly to build, an accelerator production of tritium facility at DOE's Savannah River Site in South Carolina.

← Keith Roe (second from left), chairman and president of Burns and Roe Enterprises Inc., recently met with New Mexico Gov. Gary Johnson (second from right) to discuss economic development. Joining them were Gary Bratcher (far left), New Mexico secretary for economic development, and Rich Joseph of Los Alamos' APT Project Office. Burns and Roe was awarded the DOE contract to design and possibly build an accelerator production of tritium facility.

Paul Lisowski, leader of the Accelerator Production of Tritium project, says that during the next five years, Los Alamos will produce a conceptual design and work with Burns and Roe on the final design for the proposed APT plant at the Savannah River Site. Burns and Roe also will support engineering, development, and demonstration activities at Los Alamos.

These segments of the project are worth more than $350 million. The project is expected to support nearly 500 people at Los Alamos, Savannah River, and other participating organizations in fiscal year 1998, and job opportunities will become available once the prime contractor moves into the area.

To produce tritium using an accelerator, a stream of protons is accelerated to nearly the speed of light. The protons slam into a heavy-metal target made of tungsten and lead, knocking neutrons loose from the target. The neutrons bombard helium-3, a stable isotope, and transform it into tritium. The tritium is then extracted for use in nuclear weapons.

During engineering, design, and demonstration activities, engineers and scientists from Sandia, Livermore, and Brookhaven national laboratories, and Savannah River Site will work with Los Alamos and Burns and Roe to develop and operate several prototype systems, the most important of which is a Low-Energy Demonstration accelerator that will serve as a model for the “front end” of the Savannah accelerator. Other activities will include demonstrating the tritium-production components of the plant and performing material irradiations at the Los Alamos Neutron Science Center. The APT work at Los Alamos should result in nearly $200 million worth of procurement during the next five years.

Los Alamos' work to demonstrate technology for Accelerator Production of Tritium is part of a dual-track program by the DOE to ensure that the nation has a reliable supply of tritium — a radioactive isotope of hydrogen used to make nuclear weapons more powerful — by 2007.

One track of the program will investigate the possibility of producing tritium with a commercial nuclear reactor. The other will demonstrate how tritium can be manufactured using an APT-based system. The Secretary of Energy is expected to decide which approach will be used in late 1998.

If the DOE selects accelerator technology, by 2001 the APT project office is scheduled to be moved from Los Alamos to Savannah River, where construction of the APT plant will take place.

Tritium was produced at DOE production reactors designed and built in the 1950s. The last one was shut down in 1988. The nation's tritium requirements currently are being met by recovering the gas from nuclear weapons dismantled as part of the nation's stockpile reduction program.

Tritium has a half-life of about 12.5 years and decays at a rapid rate of 5.5 percent each year. Consequently, a supply of tritium must be available if the nation is to ensure the reliability of its nuclear weapons.

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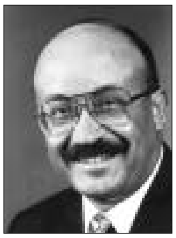
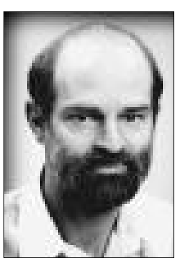
IN THE NEWS . . .



Pete Miller

WARREN "PETE" MILLER IS THE NEW ACTING DEPUTY DIRECTOR FOR SCIENCE AND TECHNOLOGY AT LOS ALAMOS. Miller, a 22-year Laboratory veteran, served most recently as acting director of the new diversity office and before that director of science and technology base programs. He also holds a joint appointment as professor-in-residence in nuclear engineering at the University of California at Berkeley. Appointed by Los Alamos Director Sig Hecker, Miller will serve in his new position on an acting basis because of Hecker's recently announced decision to resign October 1997. During the transition to the next director, Hecker hopes to show the benefits of a deputy for science and technology, a position that he said has worked well at Los Alamos' sister institutions: Lawrence Livermore and Lawrence Berkeley national laboratories. Among other jobs Miller has held at Los Alamos are associate director for physics and mathematics; associate director for energy programs; and group leader for reactor and transport theory. Miller has taught at Howard and Northwestern universities and the University of Michigan, as well as U.C. Berkeley. He holds a bachelor's degree in engineering sciences from the U.S. Military Academy and a doctorate in nuclear engineering from Northwestern University.



Gary Glatzmaier

LOS ALAMOS EARTH SCIENTIST GARY GLATZMAIER HAS RECEIVED A COMPUTER MODELING AWARD FROM THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS COMPUTER SOCIETY. IEEE presented the Sidney Fernbach Award to Glatzmaier in November for his work in developing a computer model that simulates convection and magnetic field generation in Earth's fluid outer core, the geodynamo. Glatzmaier's model, developed with Paul Roberts of UCLA, is the first dynamically consistent, three-dimensional, numerical model of the geodynamo. The computer simulations were performed at the Pittsburgh Supercomputing Center and Los Alamos' Advanced Computing Laboratory. IEEE's Sidney Fernbach Award was established in 1992 in memory of one of the pioneers of high-performance computers for the solution of large computational problems.

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BRIEFLY ...

SEVEN LOS ALAMOS RESEARCHERS WILL RECEIVE FUNDING FOR ENVIRONMENTAL CLEANUP RESEARCH THROUGH A DEPARTMENT OF ENERGY PROGRAM DESIGNED TO FUND BASIC RESEARCH ON INTRACTABLE ENVIRONMENTAL MANAGEMENT AND CLEANUP PROBLEMS. The $50 million made available to researchers from universities and national laboratories is offered by the DOE's Environmental Management Science Program, which is jointly run by Environmental Management and the Office of Energy Research. Proposals submitted by the Los Alamos researchers — Stephen Agnew, Mary Barr, Steve Buelow, Mike Murrell, Mark Pickrell, Gary Selwyn, and Barbara Smith — were selected from more than 2,000 submitted nationwide.

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