Future Tech to Service Software System Developed at DOE Installation

Future Tech Corporation (Oak Ridge, TN) has signed a service supplier license agreement with Martin Marietta Energy Systems, Inc. to provide services to the end-users of a computer software system developed at the Department of Energy's Oak Ridge Gaseous Diffusion Plant (ORGDP). Future Tech will provide services such as installation, training, updates, improvements, and error corrections for the Analytical Laboratory Information System known as AnaLIS.

William W. Carpenter, vice president of technology applications for Martin Marietta, said: "This license is the first major, government-developed computer software program from the Oak Ridge facilities to be made available to other organizations. Now that Future Tech has been qualified and licensed to provide software technical support, we can proceed to license the many other commercial end-user firms who have expressed interest. Government users can also benefit from the availability of these services." Martin Marietta Energy Systems has a copyright on the software system, AnaLIS, and will make it available to end-users outside the DOE complex under a copyright license agreement.

The AnaLIS computer software system enables analytical chemists to quickly record the results of an analysis just performed or to retrieve data on several million analyses performed previously. ORGDP, which developed the system, uses it to record hundreds of thousands of chemical analyses performed annually in the plant's analytical laboratories, to track samples, store and report test results, to maintain analyst and instrument certification records, and to provide administrative records for the analytical laboratories at ORGDP and the Paducah (Kentucky) Gaseous Diffusion Plant.

The system was recently installed at Oak Ridge National Laboratory and the Portsmouth (Ohio) Gaseous Diffusion Plant, and is accessible to other DOE installations via telecommunications.

Ultrasonic Device Can Detect Small Imperfections in Hot Steel

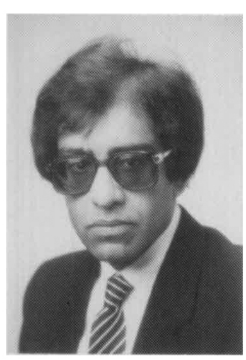
A new high temperature imperfection detector uses ultrasonic waves to detect small imperfections in hot steel. Both large and small imperfections in hot steel normally occur at the end of a rolled slab and must be sheared off before the steel is formed into a final product. Because present visual estimations cannot determine precisely where sound steel begins and the flawed steel ends, steelmakers discard some sound steel to ensure the product quality.

"This procedure is inefficient and costly to the steel industry," said C. David Rogers of the American Iron and Steel Institute (AISI). "A single steel mill could easily save more than a million dollars a year with the new device through the increase in production of usable steel."

The detector was developed during a two-year collaborative effort funded by AISI member companies. Participants included Magnaflux Corporation, the National Bureau of Standards, and Argonne National Laboratory. In tests, the device has detected a flaw as small as $\frac{1}{4}$ inch in steel at 2000°F, a significant increase in accuracy over existing methods.

In operation, the transducer which generates the ultrasonic waves is in contact with the inside rim of a three-foot-diameter stainless steel wheel. This wheel rolls over the hot steel slab, transmitting the sound waves through the rim into hot metal. The sound waves reflected off the internal imperfections are translated by a small computer into a color map of the internal structure of the slab. Each imperfection is outlined, and its shape, size, and location shown. Recent tests of the detector at Argonne have confirmed that such a device could be used in-line within a steel mill environment to clearly define the imperfections in hot steel.

A. Madan Named President of Glasstech Solar



Dr. Arun Madan has been named president of Glasstech Solar, Inc. (Wheatridge, CO), an affiliate of Glasstech, Inc. (Perrysburg, OH). Madan, a widely known researcher in the field of photovoltaic cells and amorphous silicon semiconductor material, has been vice president of research and development for Glasstech Solar since February 1985.

Under Madan's direction, Glasstech Solar achieved a breakthrough last summer with the production of its first solar energy panel utilizing thin film, amorphous silicon technology on a continuously moving glass substrate. The company is currently producing these panels on a limited basis and is evaluating the construction of a full-scale production facility.

Madan holds several basic patents on various aspects of amorphous silicon technology. In the early 1970s, he was part of a research team at Scotland's Dundee University which pioneered the use of amorphous silicon to convert solar energy to electricity, the basis of photovoltaic cells. A British citizen, Madan was previously manager of amorphous silicon development for Chevron Research Co. (Richmond, CA) during which time he was on loan to the federal government's Solar Energy Research Institute in Colorado. Also, he served as manager of research and development for Energy Conversion Devices, Inc. (Troy, MI).

Madan's educational background includes a doctorate in physics from the University of Dundee, Scotland, an MS in solid-state physics from London University, and a BS with special honors in physics from Reading University, England. A prolific author and lecturer in his field, Madan has co-authored a soon to be published textbook, *Physics and Applications of Amorphous Semiconductor Devices*; and he has spoken at technical conferences worldwide. Madan is a member of the Materials Research Society, and he was a symposium organizer and book editor for the 1985 and 1986 MRS Spring Meeting symposia on amorphous silicon and semiconductor technology. He is a symposium organizer for the 1987 MRS Spring Meeting symposium on Amorphous Silicon Semiconductors—Pure and Hydrogenated.

Magnet Provides Highest Pulsed Magnetic Fields Yet

Simon Foner, chief scientist at the Massachusetts Institute of Technology's Francis Bitter National Magnet Laboratory (Cambridge, MA), has built a magnet that provides substantially higher pulsed magnetic fields than previously possible. The development should give researchers a much better, less expensive tool for studying the electronic and magnetic properties of metals, semiconductors, superconductors, and magnets. Peter A. Wolff, director of the laboratory, called Foner's work "a breakthrough in generating very high pulsed magnetic fields."

In collaboration with Supercon, Inc., (Shrewsbury, MA), Foner developed an ultrastrong copper wire containing niobium filaments for the magnet winding and achieved fields of 68.4 tesla for 5.6 milliseconds. The copper-niobium wire was developed by researchers trying to find an easily pliable superconductor which could be used in high-field steady-state magnets, possibly for magnetic confinement fusion or for large accelerators such as the Superconducting Super Collider.

Foner, whose research was funded by the National Science Foundation's Division of Materials Research, said his work sug-

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gests that energy efficient systems of 75 tesla strength, with a pulse length nearly 100 times longer than those now attainable, can be built economically with this new materials technology.

Foner said the direct involvement of Supercon, under the sponsorship of a Small Business Innovation Research award through the Department of Energy, was essential in extending the superconducting materials fabrication technology to large-scale conductor manufacture. "This is a classic example of how basic research in one area leads to a breakthrough in another," he said.

A.W. Trivelpiece Named Executive Officer of AAAS

Alvin W. Trivelpiece will become Executive Officer of the American Association for the Advancement of Science, replacing William D. Carey, who is retiring. Trivelpiece, Director of the Department of Energy's Office of Energy Research since 1981, was instrumental in gaining support for the proposed superconducting super collider. A plasma physicist, Trivelpiece was professor of physics at Maryland before he joined the Division of Controlled Thermonuclear Research of the Atomic Energy Commission in 1976. He worked in private industry before becoming Director of Energy Research.

Superconductor Could Reach 60 Tesla Critical Field

In a January 26 press release, scientists at Argonne National Laboratory announced that a recently developed material can remain superconducting even when surrounded by magnetic fields more than one million times stronger than that of the earth. The material is the same compound of lanthanum, strontium, copper, and oxygen developed at Bell Laboratories and recently found by Bell scientists to be superconducting at 35 K.

"Our work confirms their results and adds the finding that it may break the world's record for critical field with a value of 60 tesla," said Donald W. Capone II of Argonne. The current world record of 50–60 tesla, he said, is held by an alloy of lead, molybdenum, and sulfur at near absolute zero. The highest critical field among commercially available superconductors is about 35 tesla for a niobium-tin alloy at near absolute zero. The most widely used superconductor today is an alloy of niobium and titanium with a critical field of about 12 tesla at near absolute zero (−460°F).

The ability of this material to remain superconducting when exposed to extremely high magnetic fields, said Capone, may give it several advantages over currently used superconducting materials. It could be cooled to 20 K with closed-cycle refrigeration, instead of to 4 K with liquid helium.

"The material," Capone said, "might be used in a number of technologies based on magnets, such as the magnetic resonance imaging widely used in hospitals. The superconducting components of current magnetic resonance imaging machines are cooled with liquid helium. Another application could be magnetically levitated trains that can travel at hundreds of miles per hour. A third possible use is in future fusion reactors which are expected to use powerful magnetic fields to control the plasma.

DOE Requests SSC Funding and Announces Site Selection Process

On January 30, Secretary of Energy John S. Herrington announced that President Reagan had approved construction of the Superconducting Super Collider, paving the way toward a formal budget request and congressional approval. The site selection process and some details of the FY 1988 budget request to Congress were announced on February 10.

The super collider, a unique basic research tool for high energy physics, will be a racetrack-shaped tunnel 52 miles in circumference and 10 feet in cross-section diameter. Approximately 10,000 superconducting magnets will focus and guide two beams of protons in opposite directions around the tunnel. The beams will be boosted to nearly the speed of light and allowed to collide head-on with an energy of 40 TeV, creating new subatomic particles that will be detected and analyzed.

Budget

Construction cost for the SSC is estimated to be $3.2 billion in FY 1988 dollars. Estimated costs for detectors, computers, R&D and pre-operations are $1.2 billion, for a project total of $4.4 billion. This cost assumes that land for the SSC will be provided free of charge by site proposers.

The FY 1988 SSC budget request will be $35 million, to be taken from within the Department of Energy's high energy physics budget. The request includes $25 million to continue R&D, with an emphasis on fabricating and testing full-size magnets to further refine the magnet design. The request also provides $10 million for initial construction activities, mainly for ordering long lead-time materials such as the superconducting wire to be used in the super collider's magnets.

Site Selection

DOE will issue an invitation for site proposals, including the selection criteria, in April. The deadline for submitting proposals is August 1987. "The process is designed to be fair, equitable to all parties—absolutely open and aboveboard," said Herrington, with "a timetable that will ensure both a fair hearing for interested candidate sites and a swift launching of this project."

After an initial screening by DOE, a select panel of the National Academies of Sciences and Engineering will evaluate the proposals and recommend an unranked list by December 1987. Based on the findings of the DOE's Energy System Acquisition Advisory Board, chaired by Under Secretary Joseph Salgado, Energy Secretary Herrington will designate a preferred site by July 1988. Herrington will announce the final site selection in January 1989 after an environmental impact study. If site preparation begins then, the SSC could be ready for operation in 1996. According to Robert L. Park of the American Physical Society, "The recent developments in superconductors, however, . . . could force a reconsideration of the SSC design, delaying the whole process."

Superconductivity Achieved at 98 K

A February 16 press release from the University of Houston announced that physicists at the Universities of Houston and Alabama at Huntsville have achieved superconductivity (the ability to transport electrical current with no resistance) at 283°F or 98 K. The threshold world scientists have sought to cross since the discovery of superconductivity in 1911 was −321°F or 77 K, the boiling point of liquid nitrogen. In the 75 years since its discovery, scientists have increased the temperature at which superconductivity occurs from a few degrees above absolute zero (−460°F) to −418°F. Then, in December 1986, Paul C.W. Chu and a group at the University of Houston announced superconductivity in lanthanum-barium-copper-oxide at 40 K. At that time Chu believed a transition temperature of 77 K to be a realistic goal.

The teams of physicists who made this most recent discovery were headed by Chu of the University of Houston and also a program director at the National Science Foundation, and by M.K. Wu of the University of Alabama at Huntsville. The research was funded by NSF and NASA. The NSF noted that scientists in Switzerland, Japan, China, and at AT&T Bell Laboratories in the United States are among others who have worked on materials which become superconducting below −369°F or 50 K.

Since 1980, world scientists, including Chu and Wu (a former student of Chu's)

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have investigated oxides as possible materials to achieve superconductivity at warmer temperatures. In the Spring of 1986, an IBM Corporation group in Zurich, Switzerland, announced the possible observation of superconductivity at −405°F or 30 K in a mixture of oxides.

On December 15, 1986, Chu announced the achievement of superconductivity under pressure at −387°F or 40 K. Then, on December 30, Chu submitted to the journal *Science* the achievement of superconductivity under pressure at −365°F or 52.5 K.

In addition, Chu discovered that the temperature at which superconductivity occurs increases dramatically with pressure. This pressure effect was wholly unexpected since the theory of superconductivity as it now stands does not predict it.

Roy Weinstein, dean of natural sciences at Houston, said the "Chu effect" indicates two major things. "First," he said, "it is a clear signal that we are dealing with a really new, previously unknown physical phenomenon. Secondly, since there are many ways (for instance, by alloying the material with other elements) to mimic the effects of pressure, it opens up a host of new approaches to increase the temperature at which superconductivity occurs. Pressure need not be used, and was not used in the work announced today."

The superconductivity at -283°F or 98 was achieved at normal atmospheric pressure and in a materials system different from that first suggested by the Swiss. It was achieved by the two research groups with liquid nitrogen as the refrigerant. Liquid nitrogen, at -321°F or 77, is about 10 times cheaper and 20 times more effective as a coolant than liquid helium. Until last December, only liquid helium could be used effectively as a coolant.

Chu said cheaper, more effective liquid nitrogen opens the potential for wide-ranging technological applications which were previously conceived but not practical, including levitated trains, power generators and transmission lines without resistive losses, and very large magnets for medical magnetic resonance imaging.

Chu believes superconductivity at even higher temperatures can be achieved because "there are so many directions in which to search for better materials." His group has, in fact, already seen indications of superconductivity at -27°F or 240 K. Weinstein said that temperatures such as the 98 K just announced were unthinkable a few months ago, and that the ultimate operating temperature of these new materials will probably be much nearer to room temperature than to absolute zero.

Chu's coworkers at Houston include P.H. Hor, R.L. Meng, L. Gao, Z.J. Huang, Y.Q. Wang, J. Bechtold, and D. Campbell. Wu's group at Alabama includes J. Ashburn and C.J. Torng. Results of the research have been accepted for publication in *Physical Review Letters*.

Editor's Note: The above press information from the University of Houston follows previously reported discoveries by the same groups. The compound oxide system with nominal composition $(Y_{0.6}Ba_{0.4})_2CuO_{4-y}$ was reported in *Physical Review Letters* **58** (1987) p. 908 (March 2, 1987 issue) to show an onset of superconductivity at 93 K with completion of the transition at 80 K. A companion paper (p. 911 of the same issue) reported the pressure dependence of T_c to be quite weak in contrast to observations by others on the La-Ba-Cu-O and La-Sr-Cu-O materials which had been the previous T_c record-holding compounds. The Houston and Alabama researchers believe the new Y-doped material is not in the same crystallographic phase as its La-doped predecessors. The most recent report (submitted to *Physical Review Letters* in early March) tells of a refinement to the Y-Ba-Cu-O material, wherein an onset T_c of 98 K and completion at 94 K was observed. For this material, the authors estimate that the upper critical magnetic field extrapolated to 0 K lies in the range 94 tesla $< H_{c2}(0) <$ 190 tesla.

U.K. Initiative to LINK Government, Academic, and Industry Research

Plans for Rapid Development of Products and Services from Scientific and Technological Research

A £210M United Kingdom government initiative to speed up the development of products and services from scientific and technological research carried out by universities, government departments, and industry was announced in December 1986 by Prime Minister Thatcher. Through this initiative, called LINK, the U.K. government will support up to half the cost of collaborative programs between the scientific community and industry. The government's contribution will reach £210M over the next five years. Overall, the initiative is expected to generate expenditure by government and industry of at least 420 million over the next five years, provided industry matches the government funding.

LINK will consist of a range of programs, each in a strategic area of science and technology. The programs will cover the entire spectrum of science-based technology from molecular electronics to transport systems, materials technology to food process engineering.

Commenting on LINK, Geoffrey Pattie, Minister of State for Industry and Information Technology said: "We have already done much to forge links between science, industry and commerce but this is a major initiative to increase this collaboration. If the U.K. is to become more competitive in world markets we need a constant stream of new industrial technologies, products and services. LINK will generate this."

Higher Education Minister George Walden said: "We must make scientists more aware of industry's needs and the business community more aware of the potential which science and technology offer for profitable development. LINK will be a major force in achieving this and making our academic excellence contribute more to our economic success."

The LINK initiative came in response to several problems: a reported 28% loss in manufacturing and construction in the U.K. since 1979; an acceleration of the "brain drain" to the United States, with U.S. National Science Foundation figures indicating that about 1,000 U.K. scientists and engineers are emigrating to the U.S. every year (as many as from the whole of the rest of Western Europe put together); and a devastating report from the House of Lords Science and Technology Committee, attacking the vacuum of leadership at the center of Britain's scientific and technological endeavor.

The main objectives of LINK are:

- to foster strategic areas of scientific research directed toward the development of innovative products, processes, and services by industry;
- to stimulate a real increase in industry's own investment in R&D;
- to help industry exploit developments in science and make scientists more aware of industry's needs by strengthening the links between industry, higher education, the Research Councils and other research establishments; and
- to develop technologies which cross the boundaries of industrial sectors and scientific disciplines.

LINK will have a steering committee of industrialists, government officials, and representatives of the academic community and the research councils, chaired by an eminent industrialist. The management of LINK programs will be decentralized and will use existing machinery and advisory bodies in research councils and government departments where possible. Project proposals will originate from industry, higher education, and other research establishments.

The aim is to make LINK as flexible and unbureaucratic as possible in order to speed the selection of projects and provision of funding. A small secretariat will support the steering committee and, wherever possible, industrialists' and research workers' usual government contacts will also be their LINK contact. LINK does not replace existing collaborative research

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programs such as the Alvey program and the Joint Optoelectronics Research Scheme (JOERS). These programs, and those of other departments, which have associated or complementary objectives to LINK, will continue alongside and in association with LINK.

Ten MRS Members Elected to APS Fellowship

Ten members of the Materials Research Society were recently elected to Fellowship by the Councillors of the American Physical Society. A recognition of excellence, APS Fellowship is extended only to "such members who have contributed to the advancement of physics by independent, original research, or who have rendered some other special service to the sciences."

The following eight members of the Materials Research Society were elected to Fellowship in the Division of Condensed Matter Physics:

Philip B. Allen "For contributions to the theory of electron-phonon effects in metals and semiconductors."

Tai-Chang Chiang "For his numerous contributions to the understanding of bulk, surface and interface states of metals and semiconductors using photoemission techniques."

David Richard Clarke "For important contributions to understanding atomic-scale fracture phenomena, structure and energetics of glass-ceramic interfaces, and toughening mechanisms in ceramic materials."

Eugene E. Haller "For pioneering contributions to the development of ultrapure semiconductors and significant investigations of the spectroscopy of novel defects in them."

Shirley Ann Jackson "For contributions to the theory of charge density wave instabilities, the channeling of heavy ions in solids, and the behavior of 2-D electrons on helium films."

Horia Metiu "For his insightful contributions to our understanding of surfaces and adsorbates using spectroscopic techniques to measure dynamic properties."

Gary Wayne Rubloff "For pioneering applications of surface electron spectroscopies and optical techniques to understand chemical reactions and properties of interfaces and surfaces, particularly silicon interfaces."

Clark W. White "For basic research on laser annealing of semiconductors, ion implantation, and ion-beam surface layer analysis."

The following two members of the Materials Research Society were elected to fellowship in the Division of High Polymer Physics:

Ali S. Argon "For fundamental contributions to understanding of plastic deformation of polymer glasses."

Shaw Ling Hsu "For his use of vibrational spectroscopy to characterize polymer structure and to follow the dynamics of structural change."

"Hidden Threat of Producing Electronic Components Overseas"

In an article in the National Research Council's *News Report* (November 1986), free-lance science writer Ron Cowen writes about "The Hidden Threat of Producing Electronic Components Overseas." Cowen's article, which reviews the conclusions of an NRC study requested by the Department of the Army, is excerpted below. Copies of the committee's report, *Foreign Production of Electronic Components and Army Systems Vulnerabilities*, are available from the NRC, Board on Army Science and Technology, JH424, 2101 Constitution Avenue, NW, Washington, DC 20418; telephone (202) 334-3344.

"Increased reliance on foreign-made electronic parts not only poses economic problems for American businesses, it may also threaten national security. A cutoff of the overseas supply during wartime may prove devastating to the military....

"Weaning the military from its dependency on foreign-made parts has two facets, the committee said. The United States must keep abreast of foreign competition by encouraging increased domestic production of certain strategic components. At the same time, American military planners must consider options like stockpiling components for use in an emergency.

"Exacerbating the military's problems, according to the committee, is the lack of any policy in the Department of Defense (DOD) or other federal agency 'that addresses the overall issue of growing dependency on foreign components for weapons systems.' In fact, DOD has issued contradictory policies that both encourage and discourage foreign production, the committee observed. Only one specific plan, the Very High Speed Integrated Circuits (VHSIC) program, has been instituted to recoup the American lead in electronics. VHSIC is designed to promote research and development of superfast, high quality semiconductor circuits that are expected to be an integral part of the next generation of computers.

"Looking toward the future, Japan may be edging out the United States as the leader in components made of gallium arsenide, a new type of semiconductor. Future military equipment such as target detection and missile guidance systems and computer logic and memory chips will increasingly depend on gallium arsenide parts. Transistors made of gallium arsenide are already an important element of radar-jamming devices. A sudden cutoff in the supply of gallium arsenide components due to an economic embargo or other emergency could limit spare parts for old equipment and prevent production of new systems. The committee recommended that DOD encourage American companies to produce gallium arsenide materials and strategic devices.

"...[T]he committee recommended that the Army consider selectively recording the origin of parts used in key military systems. 'What is important in this identification is to trace the source all the way back, so, for example, an American distributorship is not listed if the source is actually a foreign supplier,' the committee noted."

"To boost participation of American firms, which often choose high-profit commercial ventures over military projects, the committee proposed that DOD invest funds in research and development programs and in factory production of electronic parts. Long-term contracts may also attract more U.S. firms, the committee added. Without greater involvement of U.S.-based manufacturers, components for vital electronic systems may be lacking when the nation needs them most."

Fast Neutrons Detected in Direct One-Step Process

An organic metal neutron detector, invented by Michael A. Butler and David S. Ginley of Sandia National Laboratories, allows fast neutrons to be detected in a direct one-step process. The detector is an outgrowth of experiments by Butler, Ginley, and James W. Bryson, also of Sandia, who found that the electrical conductivity of the conductive organic polymer polyacetylene $(CH)_x$ can be dramatically boosted by irradiating it with neutrons. The increase in conductivity is linearly proportional to the total neutron fluence over wide ranges. This was the first reported observation of neutron-induced conductivity in an organic conductor and opened the way to a neutron detector based on measuring the resistance change produced when the material is bombarded by neutrons.

The device consists of a thin film of organic conducting polymer sandwiched between metal electrodes and sealed to keep out air. Electrical contacts are applied to measure the resistance changes. "From a device point of view, we think it will have a number of advantages," said Butler. The ability to detect neutrons directly and the permanency of the change are among the main advantages.

Another unique feature, said Butler, is

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its thin, flexible nature. It can be in the form of a flat film, a rod, a sphere, or other irregular shapes. The films can be grown to large areas and can also be attached to provide extremely large cross-sectional areas. In addition, a grid of electrical contacts can be fitted at different sites on a film surface and the local conductivity measured at each site.

The physics of the concept depends on the interaction between neutrons and the protons in the conductive organic polymer. The neutrons kick protons out of the polymer film, leaving behind a very reactive site and leading to p-type conductivity. Since the neutrons must break the chemical bond holding the hydrogen atoms in the polymer, there is a lower limit to the energy of neutrons that can be detected. Thus the detector is sensitive only to "fast" neutrons (10 eV or more) and will not react to slow, "thermal" neutrons.

Butler and Ginley believe that materials other than polyacetylene, such as substituted polythiophenes, may be equally good neutron detectors and be insensitive to air exposure as well. (Polyacetylene must be encapsulated.) In principle, any conductive organic polymer can be used, as long as its atoms have a sufficiently high cross-section for the neutron fluence of interest and the polymer can be made highly resistive.

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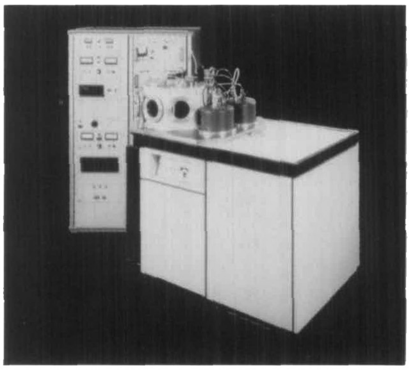

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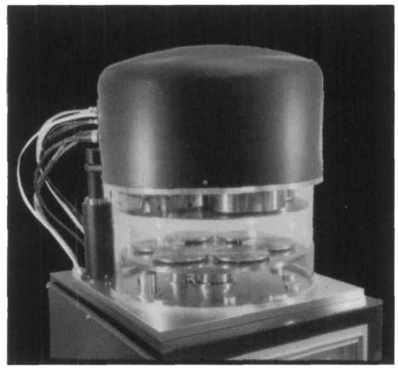

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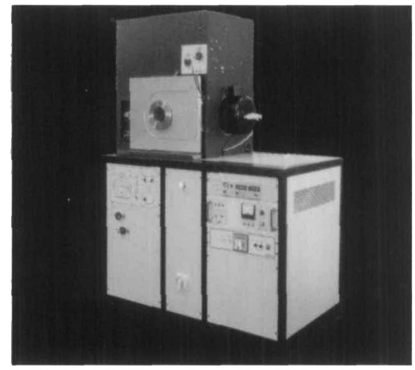

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