United States and Israel Sign Agreements for Cooperative Energy Research and Development Projects

The U.S. Department of Energy and the Israeli Ministry of Energy and Infrastructure have signed two annexes to the United States/Israeli Agreement in Energy Research and Development. The annexes establish projects in high temperature receivers and materials for hydrogen heat pumps.

The annexes established two new projects in which work will be conducted over a two-year period. The first annex matches the Sandia National Laboratory in the United States and the Weizmann Institute of Science in Israel with the objective of advancing understanding and use of ceramic receivers by conducting tests on a U.S. (Black and Veatch) ceramic receiver. The two organizations will also conduct tests on solar-heated thermochemical reactors. All tests will be conducted at the Weizmann Institute Central Receiver Facility.

The second annex involves the Brookhaven National Laboratory with the Technion to evaluate the possibility of utilizing suspensions of metal hydrides in organic or aqueous solutions as materials for hydrogen heat pumps or similar devices.

The agreement establishing the cooperative framework for energy R&D projects was signed by the two governments in June 1984 and covered energy technologies in the areas of solar energy, photovoltaics, biomass, conservation and fossil energy. Since 1984, ten annexes have been signed under the agreement covering specific projects in exchange of information and personnel, several projects in oil shale, and individual projects in coal conversion, biomass and solar energy.

Los Alamos Develops Two New Ways to Measure Superconductors

Researchers at Los Alamos National Laboratory's Medium-Energy Physics and Accelerator Technology divisions are developing two new techniques to measure the efficiency of new high temperature superconducting materials. Both measurement techniques use radio-frequency waves, whereas other measurement methods have relied on electrical contacts to gather data on superconductors. According to researchers, radio-frequency electromagnetic fields are useful in measuring superconductors because they provide information on electrical resistance without touching or affecting superconductors. The level of electrical resistance in the superconducting sample modifies the electromagnetic fields, which are measured and interpreted. The resistance is dramatically decreased when superconductivity is achieved.

Wayne Cooke, a solid-state physicist and project leader for the research, points out that the two approaches can piggyback each other and are already being used to measure the performance of new superconductors. Those superconductors are being developed in separate research programs in the Lab's Center for Materials Science and in the Materials Science and Technology division.

One of the measurement techniques, called the eddy-current technique, produces a quick analysis of a superconductor's general performance. Based on those findings, obtained in less than 90 minutes, researchers can screen potential superconducting materials and decide which ones should have more detailed analysis.

The other approach uses the Lab's first niobium superconducting cavity, for a more accurate and comprehensive analysis taking about six hours.

Lab researcher James Doss explained that the eddy-current technique measures superconductor properties continuously from room temperature to near absolute zero, about -452°F, and back up to room temperature again. Cliff Fortgang, who works with Cooke on the niobium cavity, says their approach now measures superconductors only at room temperature and at -452°F, but the device will soon be modified to take continuous measurements.

High Critical Temperature Superconducting Film Made Using Low-Pressure Plasma Spraying

Nippon Kokan (NKK), together with Tokai University Prof. Kyoji Tachikawa, has manufactured a yttrium-barium-copper oxide superconducting film using a low-pressure plasma spraying process. According to NKK spokesman the new film has characteristics superior to those now produced, and low-pressure plasma spraying is expected to attract considerable attention in the manufacture of superconducting coils, magnetic shielding materials, and other products.

In the process, oxide powders of yttrium, barium and copper are charged into a high-temperature plasma jet that melts the chemicals and sprays them onto a nickel alloy (Nimonic) substrate to form the film. The spraying is conducted in an ambience-controlled chamber where the pressure is kept between 1/40–1/4 atm. By optimizing the pressure level and the types of ambient gases present, the new process enables the creation of superconducting films whose adhesion, density and composition are superior to those of films produced by the atmospheric (1 atm) plasma spraying process.

The film produced is about 100 microns thick and has zero electrical resistance at 91 K. It has a critical current density of 700 A/cm^2 at 77 K. The Meissner effect was also confirmed at 77 K.

Non-spraying methods to manufacture superconducting films—sputtering, electron beam vapor deposition, and excimer laser vapor deposition—all produce films that are less than 2 microns thick at speeds lower than 0.05 microns per minute. NKK said its new process, produces a film with a thickness of about 100 microns at a speed more than 1,000 times faster than is possible with other methods.

Prof. Tachikawa and S. Kosugi of NKK's Steel Research Center presented the results of their research at the 1987 MRS Fall Meeting Symposium on High-Temperature Superconductors held the first week of December.

ONR Announces Expanded Graduate Fellowship Program

As one means of increasing the supply of U.S. citizens trained in disciplines of science and engineering critical to the U.S. Navy, the Office of Naval Research (ONR) has expanded the ONR Graduate Fellowship Program. ONR plans to award as many as 50 new three-year fellowships to recent outstanding graduates to support study and research leading to doctoral degrees in specified disciplines.

New ONR Graduate Fellowships awarded in 1988 will be for study and research in ten major disciplines. Specialties of particular importance to current and future naval technology are listed under ten major disciplines. Preference will be given to applicants who indicate an intention to pursue continuous study and research leading to a doctoral degree in, or closely related to, one of these specialties.

Electrical Engineering
- Integrated Circuit Design and Fabrication
- Communications
- Solid State Devices

- Electromagnetics
- Signal Processing
- Quantum Electronics

Mathematics
- Applied Mathematics
- Mathematical Statistics
- Discrete Mathematics
- Computational Mathematics

Computer Science
- Software and Systems
- Artificial Intelligence
- Architecture, Algorithms, and Software
- Advanced Automation
- Robotics

Naval Architecture and Ocean Engineering
- Ship Structures
- Structural Acoustics
- Ship Hydrodynamics
- Marine Engineering Materials Science
- Processing and Fabrication
- Composites and Fibrous Materials
- Reliability and Materials Evaluation
- Optical Electrical, and Magnetic Materials
- Corrosion Science
- Welding and Adhesion Science
- Energetic Materials Synthesis
- High Temperature Materials

Applied Physics
- Laser Physics
- Surface Physics
- Physical Acoustics
- Underwater Acoustics
- Opto-electronics

Aerospace/Mechanical Engineering
- Experimental Fluid Dynamics
- Computational Fluid Dynamics
- Energy Conversion
- High Temperature Solid Mechanics
- Manufacturing Engineering
- Systems Engineering

Biological/Biomedical Sciences
- Genetic Engineering and Biopolymers
- Neuroimmunology
- Biomaterials

Cognitive and Neural Sciences
- Biocybernetics and Artificial Intelligence
- Neuroplasticity
- Neural Architectures

ONR Graduate Fellowships are limited to citizens of the United States. Eligibility is further limited to those individuals who will receive their baccalaureate degree in 1988, or who, by reason of military service or other circumstances, have not attended graduate school in science or engineering since receiving their baccalaureate degree. Naval officers meeting the requirements are eligible for this program.

A complete ONR Graduate Fellowship Application must be submitted to qualify for consideration. A complete Fellowship Application consists of (1) master personal information form, (2) transcripts, (3) three letters of recommendation, and (4) Graduate Record Examination results (general test only).

Application materials may be obtained from the American Society for Engineering Education (ASEE), 11 Dupont Circle, Suite 200, Washington, DC 20036; telephone (200) 745-3616 or (202) 293-7080.

The deadline for filling applications for ONR Graduate Fellowships with the ASEE is *February 1, 1988*.

All applicants will be notified by letter, at their reported permanent address, of the outcome of their applications on or about April 15, 1988.

Robert Schrieffer Named Fellow at Los Alamos

Nobel Laureate Robert Schrieffer will become the first Public Service Company of New Mexico (PNM) Senior Scientist Fellow in high temperature superconductivity at Los Alamos National Laboratory. The fellowship was established as part of a two-year, $570,000 grant by PNM to Los Alamos. The research program to be headed by Schrieffer is called "Advanced Study Program in High-Temperature Superconductivity Theory." Schrieffer will spend two months a year at Los Alamos on this program.

"The program will emphasize a substantial postdoctoral, graduate student and visitor program to help establish the theoretical base which the field of high temperature superconductivity will need in the future," said Sig Hecker, Los Alamos director. "Through Prof. Schrieffer we've already recruited other top theorists in the world as participants."

Joining Schrieffer as visiting staff for portions of the coming year will be Profs. Elihu Abrahams of Rutgers University, Sebastian Doniach of Stanford University, David Pines of the University of Illinois, and T. Maurice Rice of ETH Zurich, as well as Los Alamos Fellow James Krumhansl of Cornell University.

The program will shortly begin recruitment of applicants for graduate students and postdoctoral candidates for year-round fellowships at the Los Alamos Center for Materials Science, where the advanced study program will be located. The initial program is jointly funded by PNM's grant and the Lab. Both institutions will be actively seeking other industry contributions to expand the program.

Schrieffer received the 1972 Nobel Prize in physics for his co-development of the Bardeen-Cooper-Schrieffer theory of superconductivity. He is a leading figure in the international condensed matter science community and is currently professor of physics and director of the National Science Foundation Institute for Theoretical Physics at the University of California at Santa Barbara.

Medical Applications Cited as Only Successful Current Commercialization of Superconductivity

Characterized as small but thriving, medical applications represent the only current commercial successes in superconductivity, according to a recent report in *Superconductor Week*. This view was expressed by speakers at the Institute for International Research conference held in mid-November in San Francisco. According to *Superconductor Week*, Alan Schriescheim, director of Argonne National Laboratory, predicted significant economies of scale when the new materials are adapted to magnetic resonance imaging (MRI). He indicated that MRI installation costs, now on the order of $100,000, would be reduced by approximately 50%, and that coolant bills on the order of $30,000 annually using liquid helium could be reduced tenfold using liquid nitrogen.

It was estimated that companies that manufacture MRI units spend $250,000–$500,000 on the superconducting magnet system (including cryogens, superconducting coils, and electronics), of which the superconducting component is the most expensive part.

Another area in which superconductors could be applied in medical diagnostics was seen in the area of magnetic resonance spectroscopy (MRS), which is useful in exploratory work, treatment, and surveillance of diseases. □