Solid-state fusion: a great moment in science

Solid-state fusion—"cold" fusion—is the most important discovery in this century and merits our best thinking, planning, and cooperation. Hal Fox explains.

The label "Father of Cold Fusion" could be pinned on Dr. Steven E. Jones, a professor of Physics at Brigham Young University. He and his co-workers demonstrated that fusion can take place at near-room temperature.[1] Later, Dr. Jones and his co-workers discovered that fusion can also take place in both palladium and titanium metals in an electrolytic cell.[2]

The label "Commercializers of Cold Fusion" should be reserved for Dr. Stanley Pons and Dr. Martin Fleischmann, who, working independently and without prior knowledge of Jones's work, discovered that cold fusion could produce excess heat. Fleischmann and Pons developed their electrochemical cold fusion cell, using their own funds, at the University of Utah.

After submitting their paper[3] for peer review, Drs. Fleischmann and Pons agreed to call a press conference to announce their discovery and to help ensure that proper experimental precautions were used. This remarkable discovery was widely reported in the news media.[4,5]

There is a simple explanation for the lack of ready acceptance of this momentous science discovery. An acceptable definition of scientific fact is "the close agreement of a series of observations of the same phenomena." Therefore, many scientists sought to replicate the Fleischmann-Pons Effect to determine the facts for themselves. There is no simple explanation for the gradually increasing vituperation and the resulting bad press.

Many scientists heard or read a statement by Fleischmann and Pons to the effect that the fusion experiment could be replicated using simple equipment found in a freshman chemistry laboratory. They also announced that they have been striving for about five years to achieve their results. Unfortunately, the idea was promulgated that the Fleischmann-Pons Effect was simple to replicate. Such is not the case. The Fleischmann-Pons Effect is a complex electrochemical experiment and is not easily replicated by one not skilled in the art of electrochemistry.

Another problem is the division of science into increasingly complex and increasingly narrow fields of investigation. Chemists should discover new chemicals and physicists should discover new "physicals." With the discovery of the Fleischmann-Pons Effect, fusion has melded the disciplines of electrochemistry and nuclear physics. Until now, scientists in these fields would not normally read each other's journals.

Still another complexity is illustrated by the MIT nuclear physicist who was questioned on his glumness and stated, "How would you feel if you were the Wright brothers and someone just announced the development of a space ship?" Nuclear physicists working in fusion have been developing complex and expensive machines to carry out high-temperature, high-pressure fusion experiments. Undoubtedly they could view solid-state fusion as a threat to their source of funds and/or as a threat to their livelihood.

Regardless of these complexities, there is no honorable nor scientific reason for the nasty actions by a few scientists:

- the scientist who flew to Salt Lake City and demanded to be allowed into Professor Pons's laboratory. He was informed where to go.
- the many scientists who were unable to replicate the Fleischmann-Pons Effect and accused Fleischmann and Pons

of perpetrating a hoax.

- scientists, who attended the Workshop on Cold Fusion Phenomena sponsored by the Department of Energy in Santa Fe, New Mexico in May, who were physically present at discussions of deuterium/palladium ratios; of poisoning of palladium cathodes; of unannounced additives to the electrolyte; of the difficulty of the experiment; etc., and who absorbed none of these caveats and went back to their universities to write long papers about negative results. One example among several is Reference 6.[6]
- personal attacks on the integrity of Pons, Fleischmann, or others who were announcing successes in cold fusion.
- voting on the belief in cold fusion. True science is not structured on beliefs, but on scientific facts.
- blindness to change. The unexpected absence of neutrons has been taken to prove that fusion reactions could be not occurring. The truth has been that new and important phenomena had been observed.

Progress in India and Japan

Scientists in India, working in nuclear research laboratories similar to our ten government-funded laboratories in the United States, had already been doing some work on the electrolysis of heavy water. Therefore, within three weeks after the Fleischmann-Pons Effect announcement on March 24, 1989, ten teams of Indian scientists had replicated all or part of the Fleischmann-Pons Effect. In addition, one team has extended the work to the use of titanium.[7]

Scientists in India have concluded that the amount of heat currently being generated by cold fusion could be used to design an electrical power plant with about the same energy-density as a coal-fired power plant. With 800 million mouths to feed, energy development is vital to India's national growth. Thus it is that cold fusion in India has quickly gained the support of government leaders including Dr. Raja Ramanna, defense adviser to Prime Minister Rajiv Gandhi.

Although Japanese scientists did not achieve initial early successes as was accomplished in India, they were persistent, dedicated, and not prone to condemn the results of others. At the "Workshop on Cold Fusion Phenomena,"[8] 13 Japanese scientists (University of Tokyo, Institute of Physical and Chemical Research, Yamanashi University, National Laboratory for High-Energy Physics) were listed on a paper exploring fusion in condensed matter.[9]

The Japanese learned from the Santa Fe conference. By July 31, 1989, the Japanese scientists were able to hold their own conference on cold fusion and reported that ten teams had been successful in replicating some part of the Fleischmann-Pons Effect. On Aug. 1, 1989, the Japanese press announced that 85 scientists from over 15 institutions had been organized into three scientific and experimental working groups. These scientists were charged with promoting cold fusion through experimental, theoretical, and applications studies.

By contrast, in the United States, where the discovery of cold fusion was made, the Department of Energy established a Cold Fusion Panel to the Energy Research Advisory Board. This panel visited Brigham Young University, University of Utah, Texas A&M, Stanford University, and SRI International. The interim report released by the advisory board in July 1989 included the recommendation that no funds should be allocated for cold fusion research centers at this time. Hopefully, the final report will be modified.

Cooperative research in the United States

The Electrical Power Research Institute (EPRI), representing many of the electrical power companies in the United States, became an early funder of cold fusion research. An existing grant to Texas A&M was changed to cover cold fusion research. The excellent work by professors in various departments (including the Department of Chemistry, Center for Electrochemical Systems and Hydrogen Research, and the Cyclotron Institute) resulted in the early replication of the Fleischmann-Pons Effect.[10]

EPRI joined with the National Science Foundation (NSF) in October to sponsor a three-day technical seminar on cold fusion (Oct. 16-18) in Washington, D.C. (see p. XX for excerpts). Invited papers were presented, including two from the dissidents' gallery. The many positive papers finally changed the media's view on cold fusion and the Oct. 18, 1989 press conference resulted in considerable positive reports from the news media. EPRI is to be commended both for their early funding of solid-state fusion research and for their co-sponsorship of this important meeting.

Meanwhile, many corporations in the United States pursued a variety of research and development efforts. Many, if not most, of the large U.S. corporations assigned one or more scientists the task of following the progress of cold fusion. Several corporations have been actively involved in cold fusion research. It is estimated that more than 20 such laboratories have replicated the Fleischmann-Pons experiment, but have not announced their results.

This corporate research is commendable. However, with no central organization—such as the Japanese Ministry of International Trade and Industry (MITI)—there will be a great deal of wasted scientific research and development effort by many laboratories re-inventing the same wheel.

The Fusion Information Center, Inc. (FIC) located at the University of Utah Research Park is a private corporation established to promote cold fusion development. FIC is not affiliated with the University of Utah and is the publisher of *Fusion Facts*. Recently FIC requested that all for-profit and not-for-profit groups interested in helping the United States maintain a lead in the development of solid-state fusion write to FIC. The hope is that a consortium of U.S. groups could be established to help coordinate the research and development efforts in the United States.

Plan for coordinated efforts

It is proposed that the following items become part of a plan for coordinating the U.S. research and development efforts:

1) A national coordinating committee be formed with members from corporations who are involved in or who desire to become involved in research and development of solid-state fusion energy systems.

2) The corporate members agree to exchange information about solid-state fusion research and development plans.

3) The committee list the research needs under the following categories:

Research needed to support or clarify theory.

Research needed to define optimum metal lattices that support fusion.

Research needed to improve repeatability.

Research needed to improve predictability.

Research needed to understand the effect of oscillating fields (such as increasing nuclear reactions by applying electrical or electromagnetic fields.)

4) The committee agree on the assignment of research tasks, with suitable funds, to appropriate research institutions, including university research laboratories.

5) The committee coordinate research activities with the National Science Foundation, Department of Energy, and other government funding sources with the goal of helping to coordinate the funding of research activities.

6) The committee appoint development subcommittees for the following development tasks:

Committee on standards.

Heat-exchange subsystems.

Low-heat turbine subsystems.

Direct conversion to electricity.

Fusion chemicals (including heavy water).

Other subcommittees as appropriate.

Legal implications of corporate cooperation.

7) Corporate members agree to support financially a full-time coordinating staff and to hold regular meetings.

Transferring technology to products

It is important to recognize that the optimum methods for the conversion of technology to products is better practiced by Japanese companies than by American companies. In Japan, managers have found that a close working relationship among researchers, product designers, manufacturing engineers, and marketing experts is essential for optimum technology transfer to products. In the United States, we more often separate our research and development facilities from manufacturing. The loss of important contributions from designers, manufacturing engineers, and marketing experts is a strong factor in the loss of many market opportunities.[11]

If the United States is to regain product leadership, then we must become more effective in sharing research and development efforts. However, American competition should still be expected, and even mandated, when it comes to the final product design, manufacture, and sales.

Solid-state fusion is the most important scientific development of this or any other century. A discovery of this importance merits our best thinking, planning, and cooperation. The daily press will not suffice to provide us for the latest information of the rapid developments that are being made. We need to take advantage of America's marvelous communication system and the linkages to computer data bases to keep informed.

Information on solid-state fusion is not just important for engineers and scientists. Managers at all levels may find that their industry, company, or product will be impacted by solid-state fusion developments.

Now, as no other time in our technological history, managers, should be aware of the impact that fusion energy systems will make on their industry. Some effort has already begun to provide managers with impact studies. Preliminary impact studies have been published on education, energy production, automotive industry, the environment, and agriculture.[12]

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