Load cold and slow, run hot

Dennis Cravens' five years of home-brewed cold fusion

Dennis Cravens looks relaxed in his leather bomber-jacket as he describes his experiments on the frontier of science. He speaks with a Texas drawl as he meticulously describes his five-year climb up the cold fusion "learning curve."

Professor Cravens spends most of his time teaching students chemistry and physics at Vernon Regional Junior College in Vernon, Texas—a small community in north-central Texas near the Oklahoma border. Whatever time is left over from his teaching and family life, he uses to explore cold fusion. Since shortly after Drs. Fleischmann and Pons announced their remarkable discovery to the world on March 23, 1989, Dr. Cravens has been conducting his own cold fusion experiments in his home-laboratory. He has had remarkable success. In fact, he has invented several ways to promote the still-mysterious cold fusion excess heat reaction.

As in the case of many other cold fusion pioneers, the patents for which Dr. Cravens has applied, are still mired in the log-jam at the U.S. Patent Office, which has held up a few hundred patent applications because of the prevailing skepticsm about cold fusion. However, Dr. Cravens is now also affiliated with the new Salt Lake City-based cold fusion corporation, ENECO, which has gathered his patent applications (and those of many other investigators) under its wings. When the log-jam inevitably breaks, the persistence of home-experimenters like Dennis Cravens is likely to pay off.

At the recent Fourth International Conference on Cold Fusion on Maui, Dr. Martin Fleischmann, Fellow of the Royal Society, and one of the foremost electrochemists in the world, paid Dennis the highest compliment. It was after Dennis had finished discussing his methods in a paper entitled simply enough, "Factors Affecting the Success Rate of Heat Generation in CF Cells." Fleischmann exclaimed: "You have learned all our tricks!"

Later, as the conference was ending on December 9, Dr. Fleischmann further complimented Dennis during a panel discussion summing up the proceedings. He suggested that Dennis's paper should be awarded the honor of "best paper" at the conference. (Dennis wasn't there to receive the praise in person, because he had to return home the day before.) Fleischmann said, "We have to compliment Dennis Cravens. This is real science as it should be done—in his garage, on a very limited budget. He has produced an unbelieveble amount of useful information. If you really want this to work, take it to him. He'll put you straight and get you going on the correct route."

What is it about a modest young scientist at a small college in the hinterlands that drove him to perform the kind of creative and painstaking research for which Michael Faraday—one of the great British experimentalists in electricity and magentism—would have been proud? After all, scientists at the prestigious places—MIT , Caltech, Yale, and Princeton—had all finished their Spring '89 cold fusion experiments within a matter of months and dimissed the field as nonsense. The MIT group had actually held a "Wake for Cold Fusion" on June 26, 1989, even before their group had analyzed its data. The smirks of these "big name" places, with research teams that thought they could rush science, spooked the world and gave cold fusion a bad name. Fortunately, this derision didn't stop scientists like Dennis Cravens.

Another professor of chemistry and physics, Dr. John R. Huizenga, of the University of Rochester in New York never lifted a finger to perform a cold fusion experiment. He *knew* it was all preposterous nonsense to begin with. He went on to head the federal panel that rendered a negative report against cold fusion in November, 1989, while numerous researchers, such as Dennis Cravens, were still reporting positive results on excess heat.

Clearly, Dennis's prime asset was his open-mindedness and adventuresome spirit. He engaged a lengthy series of experiments with both the "conventional" Flesichmann and Pons approach us-

VERNON (TEXAS) DAILY RECORD

Dr. Dennis Cravens in his garage cold fusion laboratory.

and fast!

by Eugene F. Mallove

ing palladium and heavy water. Later, in mid-1991 when Dr. Randell Mills announced success in obtaining excess power with ordinary water cells with nickel electrodes and potassium-carbonate electrolyte, Dr. Cravens pursued those just as vigorously. He determined which factors contributed to demonstrating excess power and which ones prevented the effect from emerging. The accompanying sidebar is a summary of what he found.

The pragmatic approach

Dennis provided *"Cold Fusion"* Magazine with helpful advice for those contemplating cold fusion experiments using palladium and palladium-alloy cathodes in heavy water. These are open cells, in which the electrochemically dissociated deuterium and oxygen from the heavy water is permitted to escape the cell as a gas—as in the original Fleischmann-Pons experiment.

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—Dr. Martin Fleischmann

Dennis's cells have been relatively small, with volumes from 2 ml to 30 ml. Most of his work has been with 3 ml cells. He followed a "pragmatic" approach to determine what factors helped to increase the temperature differential between a cell and its coolant bath. Therefore, he does not claim high-accuracy in these experiments, only that the results show general trends in what works and what doesn't work.

The excess power achieved in Cravens' cells ranges up to around 40% excess beyond the input power—referenced to a non-excess heat producing cell. Dennis says that his cells have heat transfer characteristics that produce a temperature difference between cell and its surrounding water bath of about 3°C/watt of input power. This is measured by thermocouples and a resistance heater is used to calibrate. His overall temperature measurement uncertainty is about 0.2°C, which translates to an error level of about 0.6 watt.

Dennis provided *"Cold Fusion"* with the following specific advice to enhance prospects of success in generating anomalous excess heat.

Selecting host lattice materials for electrodes

- Avoid voids.
- Do not use fold-formed Pd (palladium).
- Polish cathode surfaces uniformly.
- Avoid sharp edges and convoluted forms.
- Identify good regions of electrodes by observing bubble formation and surface coloration.
- Use cast as well as cold-rolled materials.

Preventing cracking of the host lattice:

- Use special alloys (10% Ag in Pd, 5% Re or Rh in Pd, 10% Mg in Ni, 15% La in Ni, 5% V and Sn in Ti).
- Load at low current densities (<60 mA/cm^2) until the electrode material is well into the beta phase [of palladium-deuterium crystal structure].
- Delay adding "poisons" (Al, Si, B, Thiourea) until after the beta phase.
- Pre-load by gas at elevated temperatures.
- Add materials such as Li to increase diffusion rates of D.
- Use thin films of Pd on Ag to decrease loading stresses.

Loading the cathode in a uniform manner:

- Select the geometry of the electrode configuration to avoid large variations in electrical fields over the surface of the cathode.
- Assure the uniform surface texture of the cathode by avoiding sharp corners on the cathode and properly constructing the anode.
- Use low current densities with high cell resistance (>5 ohms) during initial loading stages.

Avoiding some kinds of contamination:

- Electrolytically clean the anode material.
- Place anode connections well out of the cell.
- Minimize hygroscopic uptake (of water vapor in the air into heavy water).
- Prevent inclusion of diamagnetic materials at the surface of the cathode.

Initiating reactions:

- Employ dynamic conditions by rapidly changing the temperature (changes of 30°C or heating to 80°C), suddenly increasing the current density (by about 10 times), or exposing the cathode to magnetic field variations (RF at 82 MHz or non-homogeneous magnetic fields).