ICCF-7's Big Surprise...

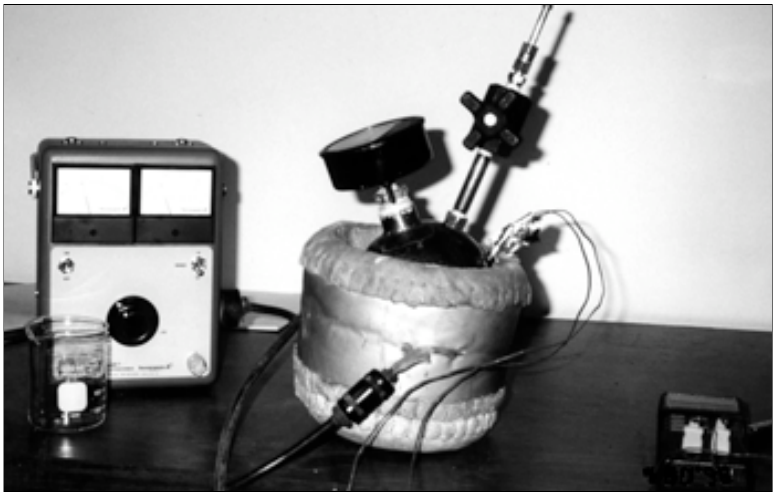
Reproducible Catalytic Fusion Process Announced by Dr. Les Case

Pending Full Validation, Commercial Applications Could Be Very Rapid

by Eugene Mallove

Dr. Leslie C. Case, an experienced chemical engineer with four degrees from MIT, surprised all of us at ICCF-7 by revealing his process of gas-phase "catalytic fusion," which he has developed over the past six years or so. He was inspired by the 1992 work at NTT labs by E. Yamaguchi—helium production and excess heat evolution from Pd in gas-phase cold fusion. (Ironically, Yamaguchi at ICCF-7 was less sanguine about the implications of his own work that can reproducibly generates excess heat from deuterium gas loading of thin-film palladium foil "sandwiches." Yamaguchi is no longer of the opinion that his excess energy is a nuclear effect, but this conclusion may not be correct.)

Even though Case lives in New Hampshire, I did not know about him. He intentionally remained quiet until his international patent announcement appeared last November. But at ICCF-7, he "told all." He has apparently discovered a very narrow range of activated carbon catalysts that are loaded with various precious metals (by weight, in the range 0.1% to 0.5%). Palladium works best so far, he says. By heating these catalysts (no electrolysis is involved), he says that considerable excess heat can be produced reliably when such catalysts are exposed to several atmospheres of heavy hydrogen gas (deuterium gas).



Dr. Les.Case's Catalytic Fusion cell, a steel gas-tight oval container used as an oxygen bottle in WW-II, sits in resistance coil heating basket (a "resin collar" used by chemists). Gauges on variac AC power supply provide accurate read-out of constant power input to heater. Activated carbon catalyst, loaded to 0.4% with palladium (commercially available) was used in the demonstration by Case at Cold Fusion Technology's lab in Bow, New Hampshire (April 30, 1998). The temperature of the catalyst with deuterium gas was elevated 13.2°C above a baseline, which was carefully established for ordinary hydrogen gas. Dual thermocouple unit (right) confirmed the temperature readings. Pressure gauge on the cell points upward. Valve for gas admission and evacuation goes upward to the right. *(Photo: E. Mallove)*

Furthermore, he has developed the all-important *null results* with heavy hydrogen on *inactive* catalysts, which behave in the same manner as exposing them to ordinary (light) hydrogen. This looks like an iron-clad control experiment. We can't see anything wrong with this, so we expect him to go very far, indeed, with his process. It is high-temperature (150 °C to 250 °C or beyond), which means that steam generation and electric power generation can't be far off if the process is confirmed multiple times to be real and robust.

What really astonished me was his demonstration right here in our lab in Bow, New Hampshire on April 30th, just after ICCF-7. He brought most of the equipment over that we needed, I provided the power supply and hydrogen gas tank. The experiment is very simple. Any good high-school or college lab could be up and running with this once it had in hand a tank of hydrogen, a tank of deuterium, and the right catalyst—the supplier of which he has disclosed. The catalysts are commercially available and off-the-shelf! I am so excited, as are others, that I immediately ordered a supply of catalyst to get to work on this.

It was so exciting to see the temperature climb above baseline and persist. As the temperature climbed to over 5 °C above the baseline (control) level, Les said to me with a smile, "We are already in the Promised Land." After 10 °C above baseline was reached, we left the experiment running in the lab and went out for supper. When we returned after an hour and a half later, it had climbed three degrees higher. After a long day of observation and preparation for the full experiment, I was deeply satisfied.

I think this may be nearly the perfect embodiment of the original Pons-Fleischmann idea. It is very clear to me that this is like the heat-after-death phenomenon that so many have reported coming from cold fusion cells: heat production with no input power after the reaction is triggered). The effect has been seen by Fleischmann and Pons (reported in *Physics Letters A*, 1993), and especially in the work of Arata and Zhang (*IE*, Issue #18) with palladium-black material. Motorola in its tests (see *IE* Issue #7) observed a multi-day heat-after-death effect in the Patterson Power Cell. Case has seen the excess heat persist for *weeks* — but unfortunately he has never let it run indefinitely.

Case has confirmed helium-4 production in the reaction by sending samples to Oak Ridge National Laboratory. There should have been more of these tests to be even more certain of the result, but I am satisfied that Case is likely to have helium-4 production. It is at such a level—100 ppm (parts per million), which is way over the 6 ppm in the air—that there is no way that it could be from "contamination." If the Oak Ridge tests were valid, I think he has nailed it. This is the reaction: D + D going to helium-4, plus gorgeous, clean, excess heat.

If replication holds up, it may be absolutely impossible for anyone to deny his process: We told him that because of the incredible hostility to the field and the immense skepticism, he simply *had* to make a device that would self-sustain—that is, employ no electrical heater power. Logically, there should be no obstacle that will prevent him from demonstrating self-sustaining very soon—in the next few weeks. He is working on it right now. Independently, others will be trying to do it too.

You see, if there is an 8-watt or more excess heat source in the cell we saw with a 13.2 °C elevation above null (this power estimate may be too conservative), there is no reason on God's earth why it should not be able to self-heat if it is simply insulated in a dewar (thermos) or the like. Then one could take out heat and/or make electricity from the heat in a controlled manner.

The most wonderful things about this catalytic fusion:

1. The process appears very well verified by an experienced scientist who has now released the *exact* recipe for anyone to do this — what the critics have been yapping about since Day One. Now the ball is in *their* court. It is *they* who must disprove *him*.
2. The process looks well-positioned to be a simple commercial power-generating technology in small, distributed units, as well as in large power plants
3. Deuterium gas is cheap (the hot fusion boys surely know that; it's what they intended to use for fuel). In theory the 8-watt-plus excess power cell demonstrated in our lab on Thursday has enough deuterium in it to last over 2,000 years at that power level. There is enough deuterium in one cubic kilometer of ocean such that when it is fused to He-4 by hot fusion or Catalytic Fusion (call it cold fusion, if you wish), the energy released equals the chemical combustion energy in all the known oil reserves on Earth.
4. This is an *existence proof*—proof of the more general idea that low energy nuclear reactions without lethal radiation *are* possible. I had already been convinced by the vast body of cold fusion and transmutation evidence, but this could be the nail in the coffin for the critics. It is just too simple a process not to spread like wildfire and gain recognition— much as X-rays did in 1895 after initial skepticism by Kelvin *et al.*

Chemical engineer Dr. Les.Case holds up his original "Mark-I" Catalytic Fusion cell at Cold Fusion Technology's lab in Bow, New Hampshire (April 30, 1998). Earlier that day, a similar cell achieved—and exceeded—the temperature elevation results that Case had predicted. *(Photo: E. Mallove)*

Another interesting fact: Using the catalyst as a cathode in a conventional cold fusion electrolytic cell, Case was able to observe a 3 °C temperature difference between a light water control cell and heavy water. But Case thinks, as would any reasonable engineer, that high temperatures of a reaction a gas process with no finicky electrodes would be preferred in a power generator.

If you are a science journalist, before you write about cold fusion—do your homework and GET THE FACTS!

PRELIMINARY CONFIRMATION TEST OF DR. LES CASE'S CATALYTIC FUSION PROCESS

by Eugene Mallove (April 30, 1998)

This is a very happy day. Dr. Les Case spent a full day here at the lab of Cold Fusion Technology, Inc. in Bow, New Hampshire. He brought his own equipment to demonstrate his "Catalytic Fusion" process, as part of an agreement we made at ICCF-7 in Vancouver, British Columbia last week. I was extremely grateful to him for having spent an entire day here, letting me watch every nuance of how he conducted the experiment. To my satisfaction, the results of today's tests confirm that a very extraordinary new energy source occurs in the reaction of deuterium gas and his specified Pd-activated carbon catalysts. We achieved a persisting excess temperature that climbed to 13.2 °C above the baseline temperature of 178.1 °C.

There is little question that with this kind of dramatic excess temperature, implying a serious excess power source of some low but significant wattage*, appropriate insulation of the cell should lead rather quickly (one hopes) to a self-sustaining device. In fact, Case is working on just such a project using an insulating dewar, which he hopes to complete in the next month. He is being fully open and wants to cooperate with us and others toward making demonstrations and devices so that this effect will become widely accepted. He also is hell-bent to scale-up to make much larger power reactors—multi-kilowatts. It appears that this may be nearly an optimal embodiment of the original Fleischmann-Pons cold fusion process.

(*) With a linear temperature extrapolation from 18 deg ambient and the 92 watt input that heated the cell to baseline temp of 178.1, the 13.2 C elevation above baseline could represent as much as 7.5 watts excess power, but it might be less. It could also be much more. Certainly it is in the multi-watt range.

Testing on April 30, 1998:

Case was here in our lab from 8:45 a.m to 8:00 p.m., so this was a very intense day. I learned a lot more about how he had discovered his process and about he believes it can be further improved and commercialized. We began by weighing out 53.3 grams of G-75D catalyst—that is a 0.4% Pd activated carbon catalyst from: United Catalysts, Inc. (Attn: Douglas Perkins, 502-634-7241) P.O. Box 32370 Louisville, KY 40232

Dr. Case recommends that we and others use the G-75E catalyst, not the "D", because "E" gives a bit better result (it is 0.5% Pd), but it was "D" that we worked with today. I have ordered 100 cc's of the "E" catalyst for our own continued work here. We will make a full-up demo starting precisely with the apparatus seen today. This appears to be such a robust process that any reasonable facsimile will do—but *the* catalyst that he recommends should be the one you start with.

The cell used is an old WW-II short cylindrical oxygen tank of 1.6 liters capacity. This is about 5-inches diameter, 7-inches tall, with spherical ends. On one end a 1/4-inch pipe is affixed leading to a steel rotary valve—a needle valve, I trust. After the valve is a gas fitting termination for alternating connection to gas filling tanks and a vacuum pump. Also welded to the tank near the top is a "half-collar" pipe fitting into which a dial pressure gage is attached.

Also on the top end is a steel thermocouple well welded to the tank—it is about 0.25 inch in diameter. It penetrates the wall at a steep incline toward the bottom and reaches a point from 0.25 to 0.5 inches from the inside tank bottom. The well is closed at its business end. Its purpose is to receive thermocouples for

measuring the catalyst temperature. I used two K-type thermocouples going to my Fluke -52 meter. I used thermocouple #1 to record data, thermocouple #2 to check against #1 occasionally. They agree to within 0.2 °C or less.

1. First the catalyst is admitted to the cell by removing the dial pressure gage. The gage is put back and the threads sealed with Ace plumber's teflon pipe thread compound.

2. The tank is attached to a vacuum pump (Lammert #10,302) and pumped down. Indication of adequate pumping—only several minutes—is when the pump sound changes to being higher pitched. Others will surely wish to use a vacuum gage, but it is not necessary. The more gas removed each conditioning cycle, the better. The valve is then closed in preparation for admitting H_2 gas.

3. Next are successive cycles of H_2 gas admission, heating, and evacuation. The purpose of this phase, prior to D_2 admission, is to get rid of all residual *chemical* activity. There are oxides and other stuff on the catalyst. By reacting these with H_2, the catalyst is cleaned and prepared.

4. We required three lengthy H_2 cycles today with this new, unused catalyst (If the catalyst had previously been used, it would not be necessary to go through all the cycles). On the first cycle, research grade H_2 was admitted from our pressure cylinder creating 50 psi in the cell (18 °C ambient temperature). The cell is placed in a "resin heater"—which is a glass fabric-coated cylindrical resistance heater measuring 7-inches diameter and about 8 inches tall. The cell sits loosely in this "nest." The power source for the heater was our variac with V and A analog gauges—150 V maximum on voltage scale, 5 A maximum on current scale. We ran at ALL times at 55 V, 1.67 A. ONLY two or three times—and ONLY during the catalyst conditioning phases -- was it necessary to nudge the voltage knob even a tiny bit (less than 0.5 volt) to bring it back to 55 V.

5. The first cycle lasted from 9:47 a.m. to 11:20 a.m. and the ending temperature had stabilized to 183.1 °C for about 9 minutes at the end—pressure and temperature readings were manually recorded at several minute intervals. The temperature stabilizing meant it was time to evacuate and refill—chemical reactions and heating had reached steady state. The unit was discharged to the air—steam and bulk water was visible, as well as old catalyst dust in the valve. This water comes from the combination of H_2 with oxides on the catalyst surface.

6. Evacuation and pump down was followed by H_2 gas refill (53 psi at 102.5 °C starting temperature) for the second cycle. [At each gas fill, Dr. Case bled some hydrogen out of the regulator before opening the valve to the chamber — this is to remove air from the pipe pathway.] This second cycle lasted from 11:25 a.m. to 1:06 p.m. and the temperature stabilized at 182.0 °C for about 8 minutes. Again the gas was exhausted to the air and much less steam—about 10% of the first cycle was noticed.

7. Pump down for the third cycle, admitting H_2 at 50 psi (144.2 °C starting temperature—the power is turned off to the heater and the tank removed from the nest, so it cools down while being evacuated and refilled.) This cycle lasted from 1:10 to 4:07 pm (we had left the lab for about 45 minutes for lunch at the Grist Mill restaurant in Bow, NH). Temperature stabilized at 178.1 °C for the last nine minutes. Dr. Case deemed this the baseline temperature ; he noted no visible steam on exhausting the gas. He noted that the several degrees above this determined baseline temperature could be accounted for by the exothermicity of the chemical reactions.

8. Pump down in preparation for admitting deuterium gas. Fill cell with D_2 gas to 48 psi (start at 145.0 °C) at 4:10 pm. The cell began to heat and by 4:51 had crossed the 178.1 °C baseline and was moving into the nominal excess power regime. Dr. Case noted in advance that he would not be satisfied unless a persisting elevated temperature of at least 5 °C was observed. That has been his criterion over the years for an obvious catalytic fusion active catalyst. We achieved much better than that...

By 5:58 pm. the temperature had reached 188.3 °C—over a 10.2 °C elevation—and it was still climbing. We took a break and went for supper. Returning to the lab, we found at 7:37 p.m. the temperature at 191.0 °C and it was continuing to climb (by 7:42 pm it had reached 191.3 °C)—Case noted that this was to be expected to occur the next few hours and in the *weeks* that these effects have been seen to persist in past experiments. He has held elevations of this sort for at least three weeks, and even then turned the system off *not* because it had failed, but to have the gases tested. He has found from 90 to 100 ppm helium-4 in gas from his cells tested at Oak Ridge National Lab — far above the 6 ppm atmospheric background. Both Dr. Case and United Catalyst's Doug Perkins suggest that it ridiculous to say that He-4 could be liberated from the catalyst—the temperature cycling with H_2 and subsequent evacuations would surely eliminate it even if it were there. The catalyst is made from carbonized coconut shells and Pd—unlikely traps for He-4 anyway. Case has had something like five He-4 tests, but obviously more tests will be in order.

As to the suggestion by some that methane forming reactions can be responsible for the temperature rise— methane does *not* form below 1500 °C according to Doug Perkins. Furthermore, why would they form only with D_2? Finally, chemical reactions from such a small reaction mass could not produce watts of power for weeks on end.

Dr. Case told me that he expected that the elevated temperature would persist for weeks if not months and there might be a further temperature rise. He left me a teaspoon full of unused catalyst as a sample and took his cell back to his lab near the New Hampshire seacoast. I wished we had been able to leave it here, but Case's confidence that we would achieve our own results and see long duration runs was itself impressive. He showed me his "Mark -1" cell design, not much different than what he has now.

Watch our WWW site for further details of testing. We are happy that Scott Little of EarthTech, Dr. Mike McKubre of SRI International, and others will be checking out this process. A large end-user U.S. corporation is also doing so. Based on what I saw today and the lengthy description of how this all came about, I am quite convinced that this is real excess heat that can persist for long periods. I trust that the helium results at Oak Ridge were done properly, which by themselves would confirm the validity of the catalytic fusion process.

Dr. Case says that he has developed his own proprietary catalyst that is better than the available commercial material. He says this new catalyst typically will give temperature rises in the range 20 to 30 °C above baseline. It seems to me, however, that the off-the-shelf G-75D or E should be quite good enough for demonstrations and self-sustaining devices.

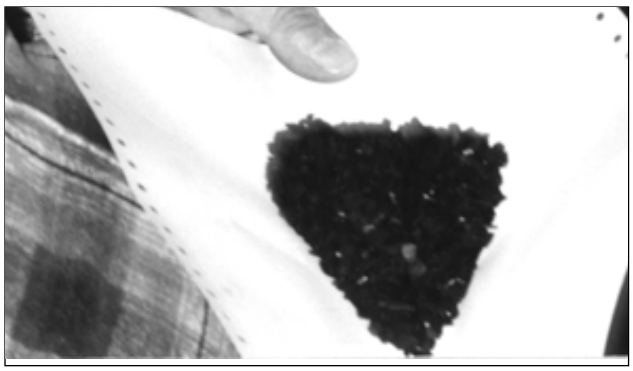
Dr. Case means business with this. He is going to ramp up the commercialization of this very rapidly with demonstration units and joint ventures with any power companies—or any other entities—that are willing to climb aboard. He recognizes

Dr. Les Case admits hydrogen gas from our H_2 tank via a pressure regulator into his prototype catalytic fusion reactor (April 30, 1998). Hydrogen cycling, heating, and evacuation of chemical reaction products is essential to conditioning the catalyst prior to admitting deuterium gas to the reactor. Then the excess temperature effect is seen. *(Photo: E. Mallove)*

that individual dwelling units that heat and generate electricity are going to be a major target. Getting the power density up higher is a key goal for him. He is particularly interested in getting this power source to countries such as China, which are about to do such unfortunate things as blocking the Yangtze River with giant hydro dams.

Dr. Case grew up in Oklahoma, but has lived in Massachusetts and New Hampshire most of his adult life. For a time he operated his own polymer chemistry firm in the Nashua, NH area (Eltron, Inc.). He has taught Chemical engineering at Tufts University and at Purdue University. Dr. Case has four degrees from MIT — two S.B. degrees (Chemical Engineering in 1952, and Industrial Management, as it used to be called), SM in Chemical Engineering Practice, and an Sc.D. in Chemical Engineering. His father was a geochemist who worked in Oklahoma for Gulf Oil Corporation all his life, helping them deal with water pollution problems in water pumped up with the oil.

Dr. Case is well-traveled in Asia and in Europe. His hobbies include classical music and wine tasting! He never misses an opportunity to visit fine vineyards. His late wife was a Ph.D. physical chemist who was born in Philadelphia on July 4th! Her parents were native Germans who returned to Germany, but then after her youth she came back to the US. Case's brother is a retired manager from the General Electric power systems area. All in all, Les Case is a fascinating person and his work is wonderful.



Dr. Les.Case holds paper with 53.3 grams of United Catalysts, Inc. 0.4% Pd-loaded activated carbon catalyst prior to placing it in his Catalytic Fusion chamber during the experiment to demonstrate excess thermal power in Bow, New Hampshire (April 30, 1998). *(Photo: E. Mallove)*

• NOTE: Estimating excess power in the 1.6 liter calorimeter:
55 V X 1.67 A = 91.9 watts input power
178.1 °C - 18 °C (ambient) = 160.1 °C rise for that input power
91.9/160.1 = 0.57 watt/°C estimated calorimeter constant (IF roughly linear — big IF at the high temperature end. The estimate may be too conservative.) Therefore: 13.2 °C elevation X 0.57 W/°C = 7.57 watts estimated excess power.

Description of G-75 series catalyst by United Catalysts, Inc

Typical Chemical and Physical Properties

PALLADIUM ON ACTIVATED CARBON

Effective: 8/12/83
Supersedes: 7/01/80

Catalyst Type.....G-75
Catalyst Form.....Granules
Catalyst Size.....4 x 8 Mesh

Chemical Composition	Weight %
Pd*:	
G-75A	0.10 ± 0.01
G-75B	0.20 ± 0.02
G-75C	0.30 ± 0.03
G-75D	0.40 ± 0.04
G-75E	0.50 ± 0.05
S	<0.05
Activated Carbon	Balance

LOI to Constant Weight at 250fF*.....<5

Physical Properties

A. Bulk Density, lbs./Cu.Ft.....35 ± 3
B. Surface Area, m^2 /g.....600-800
C. Pore volume, cc/g >29.2 Angstroms.....0.20 - 0.30
D. Particle Size, Weight Percent*:
(* properties normally measured by quality control)
Above 4 Mesh .....5% Max.
Through 8 and on a 10 Mesh.....10% Max.
Less than 10 Mesh .....3% Max.

Top view of the Catalytic Fusion cell test set up at Cold Fusion Technology's lab in (April 30, 1998). In the background to the right are a Ragland triode cell (see Issues # 12,13), and a Cincinnati Group transmutation cell. *(Photo: E. Mallove)*