# ICCF-14 Summary

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## Introduction

Some 180 people attended the 14th International Conference on Cold Fusion held in Washington D.C., USA from August 10 through 15, 2008. This summary is intended to highlight the key results that I found persuasive, as well as some wider scope sociological context in which the meeting took place. This is no substitute for a careful reading of each paper in these proceedings by each interested person trying to advance the field toward the prime objective of obtaining a reliable energy source to replace our existing ones. No more significant objective can be imagined since our entire modern civilization is dependent upon enormous quantities of energy of high quality. Quality is roughly synonymous with energy density of the fuel and the higher temperatures at which it can be more readily utilized. The idea of unlocking the potential energy of the lightest elements in a fusion process is remarkable, considering the vast amount of the fuel available on the earth. The night sky shows that the universe is powered by fusion of hydrogen to helium at the high temperatures in the stars. The notion that we might release the energy of fusion in a solid at lower temperatures is a concept beyond all our expectations as recently as 20 years ago.

We have yet to demonstrate this process in a sufficiently convincing manner to attract the required effort and funding to take these observed phenomena from imperfectly predictable episodes to a demonstration of a controllable energy source of high quality. Progress over the past 19 plus years has nonetheless been steady enough to inspire a number of our scientifically-trained colleagues to soldier on in spite of the meager funding and extensive controversy.

## Sociological Context

One way to illustrate the context in which the meeting took place is to relate the background leading to the appearance of a videotaping crew from CBS's "60 Minutes" throughout the first day's proceedings. An informal inquiry led to the following picture explaining why ICCF-14 should suddenly be the subject of interest to the national media: The primary investor in the Israeli company, Energetics, Inc., apparently requested CBS's help in getting a wider audience for their reports of unprecedented net energy production by deuterium in palladium cathodes. The "60 minutes" operatives were active that first day of the meeting, interviewing several of the attendees. They asked interviewees for their evaluation of the reliability of the evidence for cold fusion production of energy. Among the list of interviewees was a representative of the mainstream physics community who was asked to advise them on when and/or if CBS should schedule this subject on the air. In my discussion with my friend Paul Grant who served in the

role of skeptical mainstream physicist, I discovered his intended recommendation was to postpone the airing for a year or more on the assumption that more reliable data would be forthcoming by then. Grant also mentioned that Richard Garwin had written a letter supporting this delay. My response to this was to quote to the CBS representative one of C. Northcote Parkinson's Laws, his Law of Delay. This law states that Delay equals Denial, in most practical bureaucratic organizational situations. At this writing it is not clear what "60 Minutes" will decide. Stay tuned!

Why bring up this tempest in a teapot? Because it illustrates the remnant of the intense controversy surrounding this field in the first few years following the announcement by Pons and Fleischmann on March 23, 1989. After 19 plus years the protagonists in that controversy, who included many mainstream physicists beyond Garwin and Grant, still feel compelled to suppress publicity about the subject. My initial reaction is that their response is reminiscent of defenders of the faith in religious wars. In today's climate in which "war" is waged for government funding of research, their response may be just another battle in that "war".

Another question to consider is "Why make a special issue over this field of research?" If the claims of cold fusion were really as unfounded as the many wild claims of truly pathological science, why not simply ignore such claims rather than actively suppress publicity about the evidence? Again, it appears that the field of energy is currently so filled with competing claims of uncertain validity that cold fusion claims are in a separate class more threatening than all the others to existing energy research interests.

To sum up this situation, cold fusion researchers are faced with a community that resists taking a hard look at the evidence we are generating; a community that appears more interested in defending turf in the battle for research funds. If the mainstream community truly believed we have no reliable evidence, why would they not just ignore us? One possible answer is the precarious situation in the traditional field of plasma fusion (or "hot" fusion). That field has persisted for over 50 years working heroically against the steep odds of finding a reliable container for hot plasma with temperatures in the 100 million degree temperature range. Having seen the situation up close in its early years (1958-1961) at Lawrence Livermore National Laboratory, it was apparent to me even then that fundamental materials and magnetic field instability problems might eventually defeat the effort. At this time, I personally prefer the odds in favor of cold fusion versus "hot" fusion! Of course, both of these approaches may ultimately prove impractical. We may be stuck with nuclear fission of uranium and thorium for the next 40,000 years, the approximate time at which even uranium and thorium supplies are depleted!

## Review of a Small Sample of Results Presented at ICCF-14

As Thomas Edison said, even failures are valuable results because they steer you past blind alleys in your search for something that works. Therefore I honor all the presenters at the conference because they all are making useful contributions. Of course there is sometimes a carryover to a meeting of scientists from the game-playing that occurs in the political arena. In that arena they are known as dirty tricks or distractions from the agendas of most people. The scientific method we hope is in the minds of attendees can usually detect such behavior,

especially when the presenter makes claims that omit the evidence for such claims on the basis of proprietary issues. Another is the assertion that the only acceptable evidence for cold fusion would be an auto driving down the street powered by it, as was expressed at ICCF-1. Finally the assertion that only extraordinary evidence would support extraordinary claims is made by the same people that speak against spending enough research money to collect that extraordinary evidence!

Finally, on to a few selected papers! For me, the most impressive results were given in four papers:

1) S. Lesin, et al., "Ultrasonically Excited Electrolysis Experiments at Energetics Technologies" (ET)
2) Y.Arata and Y. Zhang, "Solid Fusion" Reactor with Zero Input Energy" (AZ)
3) F. Celani et al., "Deuteron Electromigration in Thin Pd Wires Coated With Nano-Particles:Evidence for Ultra-Fast Deuterium Loading and Anomalous, Large Thermal Effects" (IT)
4) M. Swartz, "Excess Power Gain and Tardive Thermal Power Generation using High Impedance and Codepositional Phusor ™ Type LANR Devices" (MS)

Paper (1) ET:

Using ultrasonic (US) cleaning and modification of cathode surfaces along with varying the current to the cathode by use of their 3-frequency super waves by magnitudes of around 10%, some ratios of output heat to input electrical energy of 30 to 1 were observed for times up to 40 days at net output powers up to 32 watts. While this is still far from a commercially interesting heat source, it represents a large step forward toward such an objective. If the Arata-Zhang experience in finding the He-4 ashes of the heat generation process almost entirely sequestered within the metal phase, then these cathodes represent possible He-4 contents that would be easily measurable. Also noteworthy is the extensive collaboration between the McKubre-SRI, Violante-ENEA, and the Hubler-NRL groups in achieving these impressive results. Many challenges remain, since the US process sometimes destroys the integrity of the fairly fragile cathodes.

Paper (2) AZ:

Applying high gas pressures of $D_2$ and $H_2$ to nanometer sized Pd and Pd alloys mixed with nanometer diameter $ZrO_2$ apparently gives a larger heat effect with $D_2$ versus $H_2$. Both give the expected exothermic heat of hydrogen absorption widely observed as a chemical heat effect. After several hundred hours the $D_2$ case remains above ambient temperature by 1.6°C as opposed to essentially null temperature difference with $H_2$. This experimental evidence is not so convincing until we consider the data on He-4 content. The metal samples are evaporated in the source chamber of a mass spectrometer in which the $D_2$ sample shows 1E17 atoms of He-4 whereas no appreciable He-4 is observed in the $H_2$ sample. The only input energy to the system is that of the energy density of the compressed gases. If this work is confirmed, it says that permeation of $D_2$ gas through a metal matrix is the active process producing the cold fusion reaction. The role of the $ZrO_2$ particles is apparently to prevent agglomeration of the nanometer

sized Pd and Pd alloy particles. Apparently the surface of the particles is essential to success, even though the He-4 appears to remain with the metal particle and not escape to the gas phase.

Paper (3) IT:

Celani and coworkers from throughout Italy showed the most innovative departure from previous studies. Pd wires in the 50-100 micron diameter range were bundled with two Pt wires in a set of individual fiberglass insulating tubes and exposed to 5 to 6 bar $D_2$ or $H_2$. The Pd wires were coated with a chemical mixture that resulted in nanometer sized Pd particles coating the Pd wire. Calibration with He-4 gas gave a system not subject to significant variation in heat transfer conditions. The two Pt wires served as a calibration joule heater and distributed thermometry, respectively. The $D_2$ case showed an extra 5 watts with 52 watts input whereas the $H_2$ case gave less than 1/3 as much. These wire systems are fragile and many experiments failed early. One set of wires lasted for 50 days, however. A major fraction of the excess power was obtained when 10 watts of input power was added by current applied down the axial length of the Pd wire. Even though extremely rapid loading was observed with the coated Pd wire, the electromigration was carried out with Pd in the lightly loaded alpha phase. This was done because the diffusion rate of $H_2$ or $D_2$ is 100 times faster in the alpha phase than in the highly loaded beta phase! The advantage of this and other gas-metal systems is their ability to operate in the several hundred degrees Celsius range at which the energy produced will be more commercially useful. It will be interesting if He-4 is found in the active Pd wire in amounts commensurate with the excess heat observed.

Paper (4) MS:

Swartz has produced a long series of papers on calorimetry of Pd and Ni using nearly pure electrolytes of very high impedance, hence requiring much higher voltages than is widely used by other electrochemists. His results show excess power and energies well above any reasonable uncertainties, and in a few cases observing excess heat with Ni in light water. His evidence for socalled heat after death (HAD) after all input power is turned off is particularly convincing. If He-4 has been produced within all these cathodes, they should be tested for He-4 content to compare with the total excess energy produced during the life of each cathode.

Other interesting papers include those by Dufour et al., Nohmi et al., Parchamazad-Miles, and Kasagi et al.:

Dufour used an ice calorimeter of high accuracy to observe the known heat of absorption of Pd by $H_2$ and $D_2$. In the $D_2$ case, evidence for a delayed heat effect was obtained not present in the $H_2$ case in one of two attempts. Again as with the AZ experiment, simple loading to normal levels (0.6 D or H per Pd atom) appears to trigger an unusual excess heat effect with $D_2$ and not H2. The total HAD was about 10 joules/gram of Pd or about 1.0 Kilojoules/mole of Pd. It is not clear why HAD showed up in the first try but not in the second try. It is remarkable that all these experiments were for D and H loading in the conventional range of about 0.6 D or H/Pd. Also this was all with just a single ingestion of $D_2$ or $H_2$ at 0°C and 2 bars pressure.

Nohmi et al. made a serious and potentially effective effort to replicate the claims of AZ with fine particles of Pd. No mention was made of adding $ZrO_2$ particles. Their results using a flow calorimeter appears to be positioned to provide a credible measurement of excess energy. Their

plan is to also measure any He-4 generated, presumably within the metal particles as originally claimed by Arata and Zhang.

Parchamazad et al. explored the possibility of producing Pd particles in the well-characterized pores in the zeolites. These pores have useful characteristics for chemical catalysis. The authors believe some interesting phenomena similar to gas-metal reactions reported by others might be observed in this unique environment.

Kasagi et al. described a uniquely-designed detection system for high energy charged particles (alphas?) hypothesized to be emitted from the permeation of D2 gas through the complex Pd/CaO films used by Iwamura, et al. in which transmutations Cs→Pr and Sr→Mo have been claimed. The authors have done a heroic job of particle detection and claim that even 3 counts per day are significantly above the cosmic ray background.

## Discussion

Considering the size of the material and temperature conditions matrix among the solids and gases energized by Pons and Fleischmann's initial 1989 announcement, it is small wonder that we have only scratched the surface of possible experiments. Still lacking is a definitive measurement of both excess energy and the hypothesized He-4 ashes from that excess energy. Professor Arata and Dr. Zhang have come the closest to this objective but clearly such a clear cut connection would be the holy grail of this scientific research.

Many of the papers at ICCF-14 were light on hard evidence and heavy on hopes for more detailed experimental evidence. The lack of robust funding is the greatest impediment to resolving the scientific issues associated with this subject.

Thanks to everyone who participated in this meeting. I invite all my readers of this all too brief and inadequate summary to scan all the published papers. There are nuggets of helpful information in many of them that may eventually lead to one of the most significant research results in the past 200 years.

## Acknowledgements

I ask forgiveness from authors of many worthy papers not covered in this summary. My only hope is that this inadequate sampling will induce the reader to thoroughly mine the treasures to be found in many more of the ICCF-14 papers. The encouragement and assistance in this endeavor by Co-chairmen David Nagel and Michael Melich is gratefully appreciated.