

FUSION facts

A Monthly Newsletter Providing Factual Reports On Cold Fusion Developments

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Fusion Facts Now Reports on Both Cold Fusion and Other Enhanced Energy Devices.

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FUSION FACTS

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NEW ENERGY FOUNDATION

3rd RUSSIAN CONFERENCE ON COLD FUSION AND NUCLEAR TRANSMUTATION

OCTOBER 1-8, 1995
SOCHI, RUSSIA

16th SYMPOSIUM ON FUSION ENGINEERING

SEPTEMBER 30 - OCTOBER 5, 1995

UNIVERSITY OF ILLINOIS
URBANA, ILLINOIS

A. DOES LOW TEMPERATURE NUCLEAR CHANGE OCCUR IN SOLIDS?

Low-Energy Transmutation Conference held at Texas A&M University, June 19, 1995.

INTRODUCTION BY DR. BOCKRIS

Dr. John O'M. Bockris sponsored this historic conference and welcomed the invited attendees. The purpose of the conference was to share experimental and theoretical findings to answer the question, "Does Low Temperature Nuclear Change Occur in Solids?" Bockris mentioned that some evidence has been gathered. For example, 120 papers have reported the finding of tritium produced from experiments using palladium. Here are the presentations made at this conference:

PAPERS PRESENTED ON BASIC EXPERIMENTAL STUDIES

Thomas O. Passell (Electric Power Research Institute, Palo Alto, Calif.), "Overview of EPRI Program in Deuterided Metals."

Passell took this opportunity to report on funded research conducted at Texas A&M under the direction of Dr. Kevin Wolf. Three cold fusion cells containing small amounts of boron and aluminum in a 0.1 Molar LiOD heavy-water reactor were connected in series and operated at a constant low current for 42 days. On the 21st and 22nd day of the experiment two successive fast neutron episodes were observed at about two times background. After the completion of the experiment, the three 6mm dia. by 60 mm palladium cathodes were found to be mildly radioactive. Upon analysis it was found that all three cathodes contained about 100 billion atoms of Ag, Pd, Rh, and (in one cathode) Ru isotopes having ratios unlike ratios that could have been obtained from bombardment by high energy deuteron or proton beams. This later measurement was made to ensure that no one would claim that these isotopes could have come from inadvertent use of high-energy bombardment. Postulated nuclear reactions that could have occurred are Pd-108(d,gamma)Ag-110 or impurity Ag-109(d,p)Ag-110; Pd-102(p,alpha)Rh-99; Pd-106(d,p alpha)Ru-103 or Ru-102(d,p)Ru-103; Pd-105(d,n)Ag-106 or Pd-105(p,gamma)Ag-106; Pd-104(d,alpha)Rh-102 or Pd-

$105(p,\alpha)Rh-102$; $Pd-104(p,\alpha)Rh-101$; $Pd-104(d,n)Ag-105$ or $Pd-104(p,\gamma)Ag-105$. Note that only two of these 12 possible reactions produce neutrons. This experiment has been repeated but not with successful replication as yet.

Deuterons or protons must have somehow entered palladium nuclei with the subsequent emission of alpha particles, protons, gammas and neutrons.

If this work is replicated the tentative conclusions are: Neutron capture is precluded as the primary mechanism because these isotopes lie on the neutron deficient side of isotope stability. Deuterons or protons must have somehow entered palladium nuclei with the subsequent emission of alpha ($He-4$) particles, protons, gammas, and neutrons. Protons and deuterons can enter palladium nuclei. Similar effects [of proton capture] should be sought in light-water experiments. These type of nuclear reactions can be the source of excess heat. The following tentative conclusion: "Since the activation levels in Pd are 2 or 3 orders of magnitude above detector background, this phenomenon provides an unequivocal nuclear signature observable outside the cells because of the high penetrating power of gamma rays." [As cited by Robert Bass, in his ICCF-5 paper, some type of reactions in a metal lattice cannot emit gammas but the energy is absorbed by the entire crystal. Ed.]

Dr. T. Ohmori (Hokkaido Univ.), "Iron Formation in Gold and Palladium Cathodes."

In experiments, excess heat has been obtained from gold, silver, nickel, and tin cathodes in light-water reactors with excess power ranging from 0.2 to 1.0 watt. Some iron was produced using a gold electrode with the amount of iron being a function of the excess heat produced. The iron isotopes depart from the usual isotope ratios found in nature, therefore contamination was not a source of the iron. It was found that sodium sulphate was a better electrolyte than sodium carbonate (with same 0.5M and same current). Examination of the gold cathode showed that the iron content depleted rapidly with depth below the gold electrode's surface. **The ratio of Fe-57 to Fe-54 was much greater than the natural ratio.**

Dr. Y. Kucherov (ENECO), "Material Analysis after Glow Discharge Experiment."

The glow-discharge plasma experiments used about 1 milliamperes of current at voltages of 100 volts and higher. From theoretical considerations a variety of elements have been projected to be produced and such elements have been found in the palladium cathode after experimental use in the glow-discharge reactor. Admittedly, there are some sources of contamination for some of the observed elements, but not for all of the elements found. The conclusion is that there appear to be elements that can only be created by nuclear reactions and that it appears that both fusion

and fission reactions must be occurring in the glow-discharge gas-plasma reactor using deuterium gas and palladium cathodes.

Dr. John Dash (Portland St. Univ.), "Microanalysis of Pd Cathodes after Electrolysis in Aqueous Acids."

Dash and his graduate students have used two identical electrochemical cells in series. All of the features of each cell were the same except that one cell contained heavy water and the control cell contained light water. The electrodes used were platinum and palladium with a sulfuric acid electrolyte. After operating the cells for a minimum of five hours an SEM analysis is performed on the cathodes to determine the experimental results. Spots of activity are observed on the heavy water cathodes. When examined it is found that silver and cadmium are present in the active areas. One experiment was run for four hundred hours. There were large concentrations of gold in spikes protruding from the palladium electrodes in both the light and heavy water cells. Careful observation of the same electrode surface without further electrolysis showed that elemental changes still continued. In other experiments using titanium cathodes for 50 hours of electrolysis the excess heat raised the temperature of the active cell four degrees higher than the control cell. Post experimental examination found Cr, Fe, and Ca in one spot on the titanium cathode.

Dr. Robert Bush (Cal Poly, Pomona), "Electrolytically Stimulated Cold Nuclear Synthesis of Strontium from Rubidium."

Bush reported on the work that he and Robert Eagleton have accomplished in an ingenious light-water cold fusion experiment. The isotopic abundance of rubidium is well known. If rubidium can be changed to strontium by proton capture in an electrochemical cell, the isotopic ratio of the strontium **would be different than the natural isotopic ratios.** This elegant experiment was conducted, mass spectrometer measurements were made, followed by chemical

The isotopic ratio clearly confirms that the strontium could not be explained by contamination!

analysis in which the isotopes of strontium were separated and measured. The end result conclusively proves that the strontium (which is not present in either the nickel electrode, nor in the electrolyte) is present on the surface of the nickel cathode after the experiment was conducted. In addition, the isotopic ratio clearly confirms that the strontium could not be explained by contamination! The mechanism appears to be the entry of protons into the rubidium nuclei to create strontium elements.

Dr. Reiko Notoya (Catalysis Res. Center, Hokkaido Univ., Japan), "Low Temperature Nuclear Change of Alkali Metallic Ions Caused by Electrolysis."

Notoya reported on her light-water experiments in which before and after chemical determinations were conducted. Reportedly some potassium from the electrolyte is changed into calcium; Cs-133 produced an element of mass 134; and sodium-23 became sodium-24. Notoya apparently uses an open cell type of experimental light-water reactor.

Dr. Georgiy S. Rabzi (Ukrainian Int'l. Acad. of Original Ideas), "Mechanism of Low Temperature Transmutation."

Rabzi read a paper in Russian and it was translated for the attendees. An English translation was copied and handed to all attendees. Here are some of the salient concepts from the paper by Rabzi: During his presentation Rabzi passed several samples to be viewed by the attendees. These included a steel nut which acquired the color of copper and was reduced in size; magnetic stainless steel turned non-magnetic; and asbestos which became like a ceramic. These are all the result of low-temperature transmutation. Certain forces are used to trigger nuclear reactions. These forces are combined geo-electric and artificial fields and control of temperature. Experiments were begun in 1958 to observe transmutations in solids and liquids directly. The results are somewhat akin to cold fusion reactions but are not the same.

In the years of experimenting it was found that various electrodes were best for various materials. Electrodes of copper, aluminum, titanium, and stainless steel have been used. Materials that have been used in experiments include zinc, carbon, graphite, lead, table salt, silica sand, fuel oil, etc. As an example of a typical experiment a sample of 99.5% lead was treated on March 15, 1994 at 650 C and yielded Pm, Cd, Ge, Ag (0.25%), and Au (0.21%). In an August 1, 1994 experiment silver at the level of 3% was obtained from the 99.5% pure lead. Rabzi states that no radioactivity has been observed in any of their experiments. In fact, the claim is made that radioactive atomic wastes can be stabilized.

Rabzi states that no radioactivity has been observed in any of their experiments. In fact, the claim is made that radioactive atomic wastes can be stabilized.

The many years of experiments were performed to obtain an insight into the origin of the processes involved, be the processes transmutation or cold fusion. This search has led to a better understanding of the earth processes in the changing of various elements including the energy-producing fission of uranium.

After presenting the basic concepts of his theory in the paper, Rabzi closes with the following: "I hope to have introduced by my theoretical study a fresh understanding of cold fusion as an essentially natural cold fission, a mere stage in the universal transmutation." The paper will be published in the proceedings.

PAPERS ON THEORETICAL MODELS

Yeong E. Kim and Alexander L. Zubarev (Dept. Phys., Purdue Univ., West Lafayette, IN), "Uncertainties of Conventional Theories and New Improved Formulations of Low-Energy Nuclear Fusion Reactions," paper presented by Dr. Kim.

AUTHORS' ABSTRACT

We examine uncertainties of conventional theoretical estimates for low energy nuclear fusion cross-section $\sigma(E)$ and fusion rate (σv) . Using new formulations based on the optical theorem and the radial distribution function, we derive new improved formulae for $\sigma(E)$ and (σv) . Our results of the optical theorem formulation for $\sigma(E)$ indicate that a near cancellation of the Gamow factor can occur if the imaginary part of the effective nuclear interaction in the elastic scattering channel has a very weak component with a long finite interaction range. Uncertainties of conventional estimates of the electron screening effect for $\sigma(E)$ are also examined and a new alternative formulation is proposed. Finally, based on a solution of three-body Schrödinger equation and the optical theorem formulation, we derive a new formula for three-body fusion cross-section and rate and compare its predictions with conventional estimates and also with the recent experimental data for three-deuteron fusion reaction.

Yeong Kim's work is best summarized in his own words as follows:

"We have examined uncertainties due to many approximations made in the conventional theoretical formulations of low-energy nuclear fusion reactions, and presented new improved formulations which avoid some of these approximations. Some of the new formulations lead to unexpected results. One striking result is a possibility that a near cancellation of the Gamow factor (or Coulomb barrier transparency) cannot be ruled out completely at present. Another surprising result is that the large value of the 3d fusion rate recently observed in the laboratory beam experiment [of Kasagi, et al.] may be justified theoretically in terms of a solution of the quantum mechanical three-body problem. Since there are still a great deal of uncertainty and absence of replicable reproducibility at a desirable level of about 100% for anomalous effects, it is at present premature to make definitive tests and comparison of the predictions of our new improved formulations with experimental data."

During his presentation Kim stated that by using the new optical theorem **the work is almost model free and rigorous**. During his presentation at the Monaco ICCF-5 conference, Kim showed that the probability of proton capture by higher mass elements was about fifty orders of magnitude larger than proton capture with lighter mass elements **which is contrary to what has previously been the scientific belief**.

Dr. Peter Hagelstein (MIT), "Neutron Capture in Low Temperature Nuclear Reactions."

Hagelstein is a brilliant and persistent cold fusion theorist. In each cold fusion conference he has presented one or more papers that have explored new ways in which the observed experimental results can be explained. In his presentation he stated that there are eight experimental observations that are not accepted by the scientific community. These include energy transfer within the metal lattice and neutron hopping in crystals. Neutron hopping can transfer energy. Resonant emission and neutron capture by another nuclei can explain some of the observed results.

**Phonon laser phenomena
may be a part of the
cold fusion experiments.**

Hagelstein discussed the concept of a phonon laser and showed how such a phenomena may be a part of the cold fusion experiments. In addition he showed that thermally-induced neutron hopping can occur with elements having 1s orbitals (H and He), 2s orbitals such as silicon, and 3s orbitals (Sn, Cd, Te, and Xe). He concludes that in metal hydrides neutron hopping appears to be feasible. [Neutron hopping with a neutron being captured by the nuclei of a metal lattice would, of course, explain some of the experimental results of observed changes in isotopic ratios in palladium during electrolysis. This result is a form of transmutation.]

Dr. Robert Bush (Cal Poly, Pomona), "Can the Electron Catalyzed Fusion Model (ECFM) Account for Light Water Fusion?"

Bush cites Hal Puthoff's paper in which Puthoff shows that the stability of the hydrogen atom is a byproduct of the zero-point energy (ZPE) field. Bush suggests that if the ZPE is distorted by something then the electron could go into a higher energy state and thus give off energy. Bush shows that the maximum tritium production in a heavy-water cold fusion cell occurs at about 0.825 D/Pd ratio. Bush's theory shows that the tritium production function is a 12th power function and therefore can change abruptly with loading. His theory also explains the rollover of the excess heat in light-water nickel cathode environment by explanations similar to those used to explain the tritium production.

[Bush's latest theory has been criticized as being too empirical. However, the theory certainly deserves a careful consideration in our search for the parameters that are important in the production of excess heat.]

Mr. R. Davis, "General Explanation of Radioactivities in the Experiments of Deuterided Metals."

Davis presents the theoretical work of Ron Brightsen in this co-authored paper. A part of the theory explains why the numbers 20, 50, 82, and 126 are special. Davis also handed out a paper, "Application of NCM to Experimental Results" where NCM stands for Nucleon Cluster Model. See page 8.

PAPERS ON INNOVATIVE APPROACHES

Dr. T. Mizuno (Hokkaido Univ.), "Analysis of Elements for Solid State Electrolyte in Deuterium Atmosphere during Applied Electric Field."

Mizuno used an alternating current field of 5 to 45 volts and a temperature of 400° to 700°C to produce a few watts of excess thermal power. As a result of these experiments several new elements (not present in the initial materials) were observed. The basic mixture used is a combination of Sr, Ce, Nb and oxygen with other impurities about 38 parts per million. After a process of sintering, refining, sintering, and plating, this type of proton conductor was used in the experiment at low pressures and with 5 to 45 volts potential. Over a period of 5 to 6 hours excess heat was observed. Analysis of the material using SIM showed that several elements were produced including Al, Bi, Sm, Gd, and Dy.

Toby Grotz, Dr. Timothy A. Binder & Ronald J. Kovac (Univ. of Sci. & Phil.), "Experimental Examination of Russel's Theory of Transmutation."

About one hundred years ago Russel claimed to produce transmutation. Grotz, Binder, and Kovac have been attempting to replicate Russel's work. This presentation showed that they have had modest results in such replication. Binder briefly presented Russel's table of elements and its structure. Grotz reported on their experiments in which they produced some fluorine from water vapor using electric and magnetic fields. Ron Kovac showed the results of some of his vacuum plasma studies in which he has produced an element having a mass of 5 (which is not usually presented in the mass spectrographic charts). These experimenters are some of the few who have deliberately tried to establish the serious nature of transmutation of elements and have had experimental successes.

Dr. Thomas Claytor (Los Alamos Natl. Lab.), "Tritium Production from a Low Voltage Deuterium Discharge on Palladium and Other Metals."

Claytor has been working for several years trying to find relatively low energy methods to produce tritium. Tritium has been produced by bombarding heavy water with floods of neutrons from an atomic reactor, a very expensive and environmentally hazardous process. Tritium is a key ingredient in hydrogen bombs and costs about \$32,000 an ounce. Even with the cold war being over, there is still some interest in the production of tritium for military (defense) purposes. Claytor is using a plasma-type device to produce tritium in substantial

amounts. At the present time the production of tritium is still not a resounding commercial success.

[Editor's Note: A person under contract to the DOE was present at the meeting and cited the commercial importance of the production of tritium. It is difficult in this time of relative peace to become serious about the production of tritium when the great need for the world is to produce non-polluting energy.]

Mr. D. Hudson (private researcher), "Orbital Rearrangement of Mono-atomic Elements (ORMES)."

Hudson has been doing intensive experiments with gold, nickel, and copper. He has been able to demonstrate that some elements can be made essentially "invisible" to most chemical measurements and then restored so that the elements are measurable. Hudson showed copies of several articles, mainly from peer-reviewed literature and textbooks to indicate that there are some strange results that differ markedly from standard accepted chemistry. For example, Hudson shows that when certain elements are reduced from metals (large arrays of atoms) to states where only a few atoms are clustered, then the normal metallic behavior of these elements is dramatically changed. These experimental results are being investigated by other researchers working in the nanomaterials area. Hudson says to get a metal out of the metallic cluster give the element something that it wants more than it wants itself. Two such separation elements are lithium and sodium.

[Hudson has applied for some patents on his findings. His work is unusual and worth further investigation. Some of the materials that he has formed appear to have a beneficial effect on health. His presentation was logical and impressive. The short presentation was inadequate for Hudson to describe all he had discovered during the past several years of intensive research.]

Dr. Roberto Monti (Burns Development Ltd.), "Variations of the Half-lives of Radioactive Elements and Associated Cold Fusion and Cold Fission Reactions."

Dr. Monti first came to this editor's attention at the ICCF-3 at Nagoya, Japan where he handed out a formula for transmutation of some elements by an explosive or "ignition" method. At this conference Monti described his work in which he believes that cold fusion and cold fission are complementary and reversible. He described experimental results in which after "ignition" the chemical composition of the materials was dramatically different than the initial conditions. **Of great interest was his reports on work with radioactive materials in which the radioactivity was greatly reduced after ignition.**

[Dr. Bockris mentioned the claims that if some radioactive materials were heated to 1000° to 1500°C that the radioactivity decreased and asked if anyone was familiar with that work. None in the audience was acquainted with such work.]

General Discussion at Meeting's End:

There was a discussion of producing proceedings of the conference. Hal Fox, President of Fusion Information Center offered to publish the proceedings if the presenters would get papers to him within thirty days. A copy of the proceedings would be given to each person providing a paper and the proceedings would be offered for sale. Mr. Bauer from Burns Developments Ltd. (Canada) mentioned that his company has offered to pay for experiments with radioactive materials to show that the Monti techniques could reduce the radioactivity. He had not had success in contacts with scientific officials in either Germany or in the U.S.

FIC EDITOR'S COMMENTS

This was an important first in modern science: A serious conference with twelve papers presented by academic or recognized industrial scientists. Four additional important papers were presented by non-academic private experimenters. Thirty-four concerned scientists, researchers, and journalists were invited and 27 were able to attend this international conference. Four came from Japan, 1 from Canada, 1 from Italy, and 1 from Ukraine.

There is no question but that low-energy nuclear change is a controversial topic.

Every paper presented either experimental (12 papers) or theoretic (4) evidence for low-energy nuclear changes within or near the surface of various metals. Much of the evidence is an outgrowth of the international work on cold nuclear fusion. There is no question but that low-energy nuclear change is a controversial topic. Currently accepted scientific theory denies low-energy changes. **One of the most prevalent established scientific beliefs is the inability of a charged particle (such as a proton or a deuteron) to penetrate the Coulomb barrier**, especially in metals where the atomic model presents a cloud of orbiting electrons that shield the nuclei. Kim has shown, theoretically, that a hydrogen ion is more likely to penetrate into a high mass element (by fifty orders of magnitude) than to penetrate into a small mass element (like lithium). This theoretical discovery, based on the optical theorem, is strongly substantiated by experimental evidence.

The findings from these 12 experimental and 4 theoretical papers are important. **All of the diverse experimental papers substantiate the concept that low-temperature or low-energy nuclear changes can occur. This concept is buttressed by new theoretical considerations, especially related to neutron hopping or "proton capture". In furthering our understanding of matter, nuclear changes, and new energy sources, this scientific approach may be the most fruitful area of scientific investigation to be proposed in this generation.**

You will want to get a copy of the proceedings which will be published by Fusion Information Center in about four weeks.

Proceedings of the
Conference on Low-Energy Transmutation
- held at Texas A&M on June 19, 1995 -
will be available from the *NEN* office.
The proceedings will sell for \$75 per copy,
with a pre-publication order price of
\$50 until August 1, 1995.

We are pleased to be able to provide the attendees at the **Low Energy Nuclear Reactions** Conference with Proceedings of the Conference.

B. THE COLD FUSION THEORY CONTROVERSY

By Hal Fox

The various observers/reporters who have written their impressions about the ICCF-5 conference certainly treat the idea of cold fusion theory in a variety of ways. After six years of reading over 2,000 papers on cold fusion (perhaps one-fourth of them theory papers) it comes as a surprise to read "there is no adequate theory on cold fusion." That finding was expressed in perhaps the best and most complete theory review paper, by Chechin, Tsarev, Rabinowitz and Kim ("Critical Review of Theoretical Models for Anomalous Effects in Deuterated Metals," *Int'l. J. of Theor. Phys.*, vol 33, no 3, 1994, pp 617-670, 173 refs). To my knowledge, there is only one paper that has met the challenge of these authors, the theory paper by Dr. Robert W. Bass ("Resonant Transparency Spectrum of Deuterium Lattices in PdD₁₀ Cold Fusion Reactors," poster paper, ICCF-5).

Here are the essential elements: Bass uses only basic, accepted physical principles; he shows his mastery of the difficulties by his use of the Madelung equations to prove the broadening of the deuteron energy well; he cites experts in nuclear physics who prove that the long-sought huge gammas are prevented from being ejected by a metal lattice; and he calculates the Schwinger constant with high accuracy. The only "fudge factor" at all is his suggestion that zero-point energy (which is the cause of the Lamb shift and provides the stability for atoms) as a source for a bit of energy needed to increase the energy level of the wave functions of some trapped deuterons. However, after over 400 peer-reviewed articles on zero-point energy, this should be an accepted scientific feature to use in a theory.

We need to be reminded that a theory is based on a model of reality. No model is totally accurate. Mathematical equations are

based on (or defines) a model. However, a good theory can often be used if the model of "if this....then....". The predictive "then...." can often provide an insight into further measurements and tests to be made. In fact, Dr. Bass does complete this concept. He proposes a relatively simple test that can be made in a well-equipped cold fusion laboratory.

The plea is, rather than complain about the lack of a theory or about there being too many theories, let's explore what is purported to be the best (most capable of meeting all of the challenges) theory.

C. NEWS FROM THE U.S.

A DEATH IN THE FAMILY

FLOYD A. "SPARKY" SWEET
6/26/1912 - 7/5/1995

Floyd "Sparky" Sweet graduated M.S.E.E. from MIT in 1969, at the age of 57. He received the coveted Dean's Award for his achievements in Theoretical and Applied Science. His academic level in Electrical Engineering achievement ranks third in the history of the MIT School of Science. His work in "Resonance in Subatomic Particles" predicted the neutrino, a fundamental particle, did in fact carry a charge and supported a mass. This is now recognized as a valid concept. He was awarded a scholarship to MIT by General Electric Co. because of his extraordinary achievement in the field of Electromagnetics.

Sweet was employed prior to this by General Electric Research and Development Center of Schenectady, New York, from June 1957 to May 1962 and later served on their roll of preferred consultants. He also consulted for NASA in the area of radar transmission. In Los Angeles, California, he designed the electrical motors which still power the L.A. County Gasoline-free bus fleet. "Sparky" Sweet was well known as the inventor and developer of the Sweet VTA, an enhanced energy device.

MINNESOTA - THEORY OF DEUTERON INTERACTIONS

David Moon (Minneapolis), "Testing a Theory of Deuteron Interactions Inside a Palladium Lattice," *"Cold Fusion,"* 1995, no 6, pp 3-5.

AUTHOR'S ABSTRACT

Are you running a gas-discharge cold fusion lab? The author describes an experiment to find out how deuterons could interact coherently with a palladium lattice. A proposed way that deuterons could overcome the Coulomb barrier that keeps them apart is by oscillating coherently in long chains. Then pulses of energy can travel down the chain. Another way is for a deuteron

to steal an electron from the lattice so the deuteron becomes a neutral heavy "dineutron." Now it can easily approach another deuteron or proton. These possibilities are explored using existing experimental data and a proposed new experiment.

NEW HAMPSHIRE - NEUTRINOS?

Graham Toquer, "Neutrino Power?" *"Cold Fusion,"* 1995, no 8, pp 10-15.

AUTHOR'S ABSTRACT

My theory is that Fleischmann and Pons have stumbled on a method to tap energy from neutrinos. We are on the trail of an energy source that can serve mankind's needs for the rest of human history: clean, safe, unlimited power for everyone, forever, for free.

TEXAS - HYDROGEN IN PALLADIUM

J.O'M. Bockris, Z.S. Minevski, G.H. Lin (Chem. Dept., Texas A&M Univ., College Station), "Hydrogen in Palladium: Kinetics, Material Properties, and Fugacity," *Proc. Electrochem. Soc.*, 1994, vol 94-21 (Electrochem. and Matls. Sci. of Cathodic H. Adsorp. & Absorp.), pp 410-26.

AUTHORS' ABSTRACT

A discussion is given of hydrogen, the mechanism of surface kinetics, the associated damage within the metal and the question of pressure and fugacity within voids. Some preliminary evidence has been given which suggests that on Pd in alkaline solution the rate-determining step below about 1 mA cm⁻² is coupled discharge-combination but at higher charge densities the mechanism changes to fast discharge, slow recombination. High pressure of hydrogen appears to exist inside cavities in damaged metals. For 720 hours it was not possible to exceed pressure of around 230 atm at overpotential of -0.6 V. It was possible to observe the exit of hydrogen under anodic conditions. There were two kinds of exiting hydrogen that showed a normal exponential decline in the anodic current and that which showed humps on the decay line. Application of the Beattie-Bridgeman equation of state suggested that the pressure in the artificial cavities in the electrode was in the range of 10-10⁴ atm for overpotentials from -0.2 to -0.6 V. The fugacity varied up to a value of 10³ atm at overpotential of -0.6 V. Theory is able to rationalize the pressure dependence.

TEXAS - 1992 TRANSMUTATION

Staff, "Alchemy Nightmare," *Infinite Energy*, vol 1, no 2, May/June 95, pp 30-32.

Tom Passell, cold fusion program director at EPRI, gave an overview of the field at ICCF5 in April. Only one bit of information was truly startling, the first public revelation of work done by Texas A&M physicist Dr. Kevin Wolf under EPRI funding.

In 1989, Dr Wolf was an early researcher in cold fusion, having positive results of neutrons and tritium soon after the early P&F announcement. When the problems with false accusations of tritium spiking in Dr. Bockris' laboratory surfaced in 1990 (and were summarily disproved without any doubt), Dr. Wolf withdrew his research (without any formal retraction) even though he continued with his experiments. He was funded by one of Dr. Passell's colleagues at EPRI, a skeptic who preferred to tear down cold fusion. Dr. Wolf's experiments continued to find low-level neutrons, but nothing else.

While following up on these low-level neutrons, in 1992 Dr. Wolf made an amazing discovery. Three of the palladium cathodes from P&F electrolysis cells were found to be radioactive! Spectroanalysis exhibited multiple spectral lines of gamma emission from radioactive isotopes with masses near that of palladium. Dr. Wolf accepted these findings completely, but believed (and still does) that they had nothing to do with anything fundamentally connected with cold fusion. He prefers to believe that hypothetical Weakly Interacting Massive Particles may have caused the transmutation, via cosmic ray impacts in the earth's atmosphere.

Even so, Dr. Wolf was scheduled to speak at ICCF4/Maui in December 1993 on a topic "To Be Announced," but he was "encouraged not to attend" by his cold fusion skeptic funding agent. He didn't attend and nothing about his research was announced.

Enter Dr. Passell, speaking at ICCF5 this year, where he explained that in 1992, about six weeks after Dr. Wolf's experiments that produced gamma emissions, at least one cathode was found to be radioactive. Gamma rays from at least seven radionuclides were unmistakably observed. On the order of 10⁴-10⁶ counts were observed per peak, with a signal-to-noise ratio of ten. Statistical significance of this is extremely high, under these conditions, of there being a cold fusion reaction involved in some way, since there is no known explanation for how palladium can be made radioactive.

The article goes on to explain the makeup of the palladium cathodes and the possible nuclear changes (transmutations) that were involved. If many neutrons were able to change by some method, might there not be other changes in stable nuclei also? Mass spectroscopic study would reveal abnormal isotope ratios in the palladium, however this has not been attempted. While additional experiments could probably give a better picture of the (transmutation) results, the present minimal funding for cold nuclear effects work necessarily prohibits such experiments.

The whole thing has been bizarre, why fusion of light isotopes such as deuterium and hydrogen could have anything to do with transmutation in heavy metal isotopes is beyond our understanding at present. More research will be the only key to the as yet hidden reality behind the transmutation results.

Summary by D. Torres

UTAH - NEGATIVE EVALUATION

Steven E. Jones, Lee D. Hansen (Dept. Phys., BYU, Provo), "Examination of Claims of Miles et al. in Pons-Fleischmann-Type Cold Fusion Experiments," *J. Phys. Chem.*, 1995, vol 99, no 18, pp 6966-72.

AUTHORS' ABSTRACT

In cold fusion experiments conducted at the Naval Research Lab in China Lake, M.H. Miles and co-workers claim to have produced excess heat correlated with ^4H production, X-rays, and Geiger-counter excitation. However, scrutiny of the claims shows that unreliable calorimetric and nuclear product detection methods were used. Moreover, inconsistencies and errors are found in the data and data analysis. The juxtaposition of several poor techniques and inconsistent data does not make a compelling case for cold fusion. The evidence for cold fusion from these efforts is far from compelling. A polemic in answer to Miles et al. (*J. Phys. Chem.*, 1994, vol 98, p 1948.)

VIRGINIA - NUCLEON CLUSTER MODEL

R.A. Brightsen and Randy Davis (Clustron Sci. Corp., Reston), "Application of the Nucleon Cluster Model to Experimental Results," paper passed out at Texas A&M Low Temperature Nuclear Change conference.

AUTHORS' ABSTRACT

According to the Nucleon Cluster Model and the Periodic Table of Beta-Stable Nuclides, the proton **must** contain antimatter clusters as well as positive matter clusters. Within palladium cathodes, antimatter clusters are strongly attracted to matter clusters of the same type, **avoiding** the so-called "Coulomb barrier." The resulting reactions produce the many different radioactive species recently reported for cold fusion experiments. The $^{104}\text{Pd} (p, \alpha) ^{101}\text{Rh}$ reaction is discussed as an example.

WATER ARC EXPERIMENTS

Richard Hull, "Water Arc Experiments," reprint from *Electric Spacecraft Journal*, issue 15, 15 June 1995, p 37.

The group of Peter Graneau, Neal Graneau, George Hathaway and Richard Hull continues with its interactive effort to provide a simple, convincing demonstration that a powerful arc discharge

in water can release more energy than the amount of energy input from a supply capacitor. Dr. Peter Graneau has suggested that the extra energy may come from a free-release of the latent heat in the water, bypassing the normal thermodynamic process. The current belief is that a cold nuclear fusion process is not involved in the generation of a suspected extra-energy output.

Richard Hull has recently assembled an entirely new experimental setup for continued tests at his TCBOR lab. It incorporates a new 20,000 VDC capacitor rated at 2 μF . It has a super-low inductance of only 20 nH! The leads to the arc gun terminals have been shortened, now having only 0.4 Ω total impedance (500 μH total circuit inductance). Additionally, new fiber-optic laser beam pickups have been placed close to the gun for taking velocity measurements.

The new capacitor/inductor circuit's impedance loss is considerably less than that of the earlier setup, as demonstrated by 29 cycles of circuit decay oscillation upon discharge, compared to the former seven cycles of decay oscillation, takes 7.5 $\mu\text{sec.}$; thus the time needed to achieve peak current ($1/4$ wave) is less than 2 $\mu\text{sec.}$ The circuit can produce 13,000 ampere peak current.

WASHINGTON - REACTIONS

James Carter (Seattle), "A Suggestion about Reactions," *"Cold Fusion"*, 1995, no 6, pp 19-20.

AUTHOR'S ABSTRACT

Palladium-deuterium fusion process could be greatly accelerated by using extremely pure samples of palladium-105. The fusion occurring in present-day experiments is happening within tiny crystals of pure palladium-105 as they occur randomly within the mixture of the six isotopes making up the palladium metal lattice. Since palladium-105 only makes up 22% of the lattice, the chances of pure palladium-105 crystals occurring randomly within this mixture of isotopes is quite small. If this fusion process is actually occurring, its rate of occurrence could be increased by several orders of magnitude by using extremely pure palladium-105 and then determining the proper electric frequency with which to create the right waves within the lattice.

It is that which we know that is the great hinderance to our learning, not that which we do not know
Claude Bernard

D. NEWS FROM ABROAD**A DEATH IN THE FAMILY**

A. N. BARABOSHKIN
(1926-1995)

by Dr. Yan Kucherov

The chemical science worldwide suffered a great loss. A.N. Baraboshkin, member of Russian Academy of Sciences and director of Ekaterinburg Institute for High Temperature Electrochemistry died. He was a legend. He was a famous chemist who was a recipient of many national and international awards. But the first time I heard about him it was "that big boss who spends eight hours a day in a chemical lab and only a few hours in his director's office." Later I learned that most of it was true. Not only was he a founder of solid electrolyte science in Russia, he remained a really active scientist through all his life. A.N. Baraboshkin was a man of indisputable integrity, never seeking political correctness but always a gentleman.

Dr. Baraboshkin listened to others opinions but if he thought you were wrong he very politely but firmly explained his points. Because of his excellent education and broad knowledge of chemistry and physics he usually was right. He ran a big academic institute for many years and still he managed to have graduate students, and be an active member of the Academy of Sciences.

Dr. Baraboshkin was always interested in new technologies. When Cold Fusion emerged, Baraboshkin was on of the few academicians who accepted it on the basis that "we must check it before we discard it." Later he organized the cold fusion council within the chemical branch of the academy and was practically the head of the Cold Fusion efforts in Russia.

Everybody who knew A.N. Baraboshkin respected him and we will miss him very much.

BRITAIN - SELF-FEEDING ANODE

Andrew Wallace, Roger J. Mortimer, Philip J. Mitchell (Dep. Chem., Loughborough Univ. Technol., Leicestershire), "A Self-Feeding Hydrogen Anode," *Proc. Electrochem. Soc.*, 1994, vol 94-21 (Electrochem. and Matls. Sci. of Cathodic H. Adsorp. & Absorp.), pp 440-460.

AUTHORS' ABSTRACT

A first stage feasibility study for the realization of a practical hydrogen anode, requiring no external hydrogen source was undertaken. The device is based around a thin plate of hydrogen-sorbing metal substrate (e.g. palladium), which is driven, in an electrochemical cell, as a bipolar electrode (an electrode having both positive and negative faces with respect to the polarizing

cathode and anode of the cell). By placing a palladium sheet (0.125 mm thick) in 1.0 mol dm⁻³ aqueous sulfuric acid electrolyte between a working cathode and counter anode, the resulting bipolar electrode could be made to generate hydrogen at its cathodic face, which would subsequently be absorbed by the palladium, diffuse through the bulk metal substrate, and be oxidized at the anodic face, thereby creating a self-feeding hydrogen anode.

CANADA - VERY MISCELLANEOUS

Press Release -- for immediate release

Three Dead Trolls in a Baggie and Atomic Improv team up to bring the world:

**Cold Fusion:
The Musical!**

May 15, 1995 -- Comedy titans Three Dead Trolls in a Baggie and the living legends, Atomic Improv, have joined forces to bring you *Cold Fusion: The Musical*. It chronicles the biggest scientific controversy of our century. In 1989 Doctors Stanley Pons and Martin Fleischmann announced to the world that they had discovered a cheap, clean, and nearly limitless supply of energy -- cold fusion. Had they? Or had they made a monumental mistake? The agony! The ecstasy! The electrochemistry! If Arthur C. Clark had written for *Mad Magazine*, it might have been something like this. The show will be running every night except Monday at 8 o'clock, starting June 1st at the Chinook Theatre (Edmonton, Alberta, Canada). Three Dead Trolls will also be booking private shows, so school groups or other interested parties should call (403) 497-0418 for more information.

Source: *Infinite Energy*, vol 1, no 2, p 53.

Newsgroups: sci.physics.fusion

Subject: Cold Fusion: The Musical

Date: 17 May 1995 16:32:47 GMT

Organization: Edmonton Freenet

INDIA - ULTRASONIC CAVITATION

S.K.H. Auluck, V.K. Shrikande (BARC), "Proposal for Replication of Stringham and George's Ultrasonic Cavitation Experiment," BARC "Cold Fusion Forum" on current research at BARC, June 22, 1995, p 16.

AUTHORS' ABSTRACT

When high intensity (1-3 W/cm²) ultrasonic waves of 20-30 kHz propagate through a liquid having a sufficiently high vapor pressure, the phenomenon of cavitation takes place. As the pressure of the sound wave goes through the negative cycle (rarefaction cycle), the pressure at a point may decrease below the

vapor pressure of the liquid or alternatively, dissolved gases may try to come out of solution. This vapor or gas or their mixture forms a spherical bubble because the surface tension tries to minimize the surface area. If this bubble forms in the initial part of the negative cycle, it starts growing isothermally by ingesting material from the surrounding liquid. In this process, it acquires momentum. Because of this momentum, it keeps growing even after the negative pressure cycle is over and the pressure is increasing. Finally, when the pressure is sufficiently high, the bubble begins to collapse rapidly, so that the collapse is adiabatic. Depending on the symmetry of the pressure distribution, the bubble may collapse retaining its spherical shape or may collapse becoming flat like a pancake. In the former case, the bubble collapse leads to a tremendous amplification of pressure and temperature, which depends, among other things, upon the polytropic coefficient $\gamma(C_p/C_v)$: the closer it is to unity, the more the amplification. In the case of the pancake shaped collapse, a high velocity jet is formed inside the bubble, which can inject the contents of the bubble into any solid surface which may be in contact with the bubble.

The experiment of Stringham and George optimizes the conditions for the occurrence of the pancake collapse and the resulting jets are utilized for obtaining high loading of deuterium into palladium. The shock waves formed during bubble collapse may additionally serve to generate a high level of phonons in the lattice which may trigger the cold fusion reaction as suggested by K.R. Rao and C.L. Chaplot. The energy released during the reaction may be deposited into the lattice phonons themselves leading to further reactions. In this way, Phonon Mediated Cold Fusion Chain Reactions may occur and lead to localized explosive melting of the material, as has been observed by Stringham and George.

It is proposed to replicate these experiments using a 250 watt, 20 kHz, 50 mm dia. ultrasonic horn system, with continuous flow calorimetry. The various components are at the planning/procurement stage.

INDIA - SEARCH FOR PARTICLES

R.P. Anand, T.K. Basu, D.V.S. Ramakrishna and M. Srinivasan (BARC, Neutron Physics Div.), "Search for Anomalous High Energy Charged Particle Emission During Bombardment of 140 KeV Deuterons on Ti Foils (Takahashi Experiment)," BARC "Cold Fusion Forum" on current research at BARC, June 22, 1995, p 15.

AUTHORS' ABSTRACT

In a recent experiment carried out by Akito Takahashi of Osaka University, when pulsed deuteron beams of 243 KeV were bombarded on aluminum coated Ti and Pd foils of 3-22 μm thickness, some unusual high energy charged particles were detected in the region higher than the well known proton peak of

the conventional D-D reaction. The charged particle spectra were measured using a Si-surface barrier detector and some of the high energy charged particles were identified as helium. These helium peaks and other unusual counts in the high energy region are difficult to explain and might have something to do with the multibody fusion reactions proposed by Takahashi.

In order to confirm the emission of such high energy charged particles, a similar experiment was carried out at BARC. About 220 μA steady beams of 140 KeV deuterons were bombarded on 10-25 μm thick Ti-foils using a deuteron accelerator. In the first set of measurements, the Ti-foils were vacuum deposited with 1 μm thick Ag only on the back surface (detector side) whereas in the second set the Ti-foils were also coated with 0.1 μm thick Ag on the front surface (beam side). A surface barrier detector was used to measure the spectra of charged particles emitted from the back side of Ti-foils. The Ti-foils were thick enough to stop the 140 KeV deuterons. A prominent peak in the energy region of around 0.7 - 1 MeV was observed which has been ascribed to the normal proton peak from the expected D-D reaction. We did not observe the presence of any other high energy charged particles in any of the experimental runs which were conducted for a period of 2-3 hours. During the period of deuteron bombardment on Ti-foils, the neutrons produced due to normal D-D reactions were also counted with the help of a BF₃-counter embedded in polypropylene. The rate of neutron production was found to be of the same order as that of proton production. These experiments performed with steady deuteron beams as compared to Takahashi's pulsed deuteron beams could not confirm the emission of anomalous high energy charged particles.

INDIA - ZIRCONIUM ALLOYS

S. Banerjee (head, Metallurgy Div., BARC), "Hydride in Zirconium Alloys," BARC "Cold Fusion Forum" on current research at BARC, June 22, 1995, p 11.

AUTHOR'S ABSTRACT

Hydrides in zirconium alloys (used as fuel and pressure tubes in pressurized heavy water reactors) can play very important roles on the performance of these materials in nuclear reactors. The presence of hydrides in these alloys can lead to several practical problems such as hydrogen embrittlement caused by stress-reoriented hydrides, delayed hydride cracking (DIC) and blister formation. In this presentation crystallography of stable and metastable hydride phases and their mechanism of formation from solid solution are briefly discussed. The Time-Temperature-Transformation (T-T-T) diagrams of both these phases, illustrating the transformation sequence in alloys of various hydrogen contents, is presented. The phenomenon of hydrogen diffusion under concentration, stress and temperature gradients is briefly outlined. Finally, some of the life-limiting phenomena in pressure tubes such as hydride-embrittlement,

delayed hydrogen cracking, and blister formation will also be discussed.

Plausible Pathway," BARC "Cold Fusion Forum" on current research at BARC, June 22, 1995, p 6.

INDIA - CHARGED PARTICLES EMITTED BY Pd & Ti

A.R. Chindarkar, A.S. Paithankar, A.M. Bhagwat, G.R. Naik, S.K. Iyyengar and M. Srinivasan (BARC), "Emission of High Energy (≈ 1 MeV) Charged Particles During Implantation of 5 KeV Protons on Palladium and Titanium Foils," BARC "Cold Fusion Forum" on current research at BARC, June 22, 1995, p 14.

AUTHORS' ABSTRACT

Experimental observation of the anomalous emission of high energy (≈ 1 MeV) charged particles, when 5 KeV protons impinge on Palladium and Titanium foils are presented. Thin (100 μ m) foils of Pd and Ti were implanted with a 5 KeV proton beam produced by an RF ion source. A probe type ion beam extractor of diameter 3mm and length 13mm was employed to give a current density at the target foil of ~ 0.1 mA/cm² corresponding to total ion flux of $\approx 10^{18}$ ions/hour.

For the measurement of the low intensities of high energy charged particles, the integrating property of CR-39 SSNTD films was used. The results of the experiment show positive and reproducible evidence of emission of high energy charged particles. The average emission is estimated to be ~ 3 to 4 particles per minute. The energy estimates indicate that about 30-40% of the particles emitted have energy > 0.9 MeV. **The physics of this anomalous emission is not understood at present.**

To confirm the above results, the same experiment is being repeated with a scintillator as charged particle detector, followed by an MCA, to record the energy distribution of particles. Due precautions have been taken to shield the detector from the RF noise so as to record the low flux particle emission.

Some experiments are also being planned to load a thin (0.125mm dia.) Pd wire by immersing it in an RF plasma of H₂/D₂ after biasing it with a high negative voltage. The main objectives of this experiment are (i) to study the rate of loading through measurement of the change in resistivity of the Pd wire (ii) study the dependence of the loading characteristics of Pd wire on bias voltage, gas pressure, RF power etc. Eventually it proposed to look for possible charged particle emission and autoradiograph of the Pd sample after loading (off-line).

INDIA - CONDENSED MATTER FUSION

D.Das (BARC, Laser & Plasma Tech. Div.), M.K.S. Ray (BARC, Proc. Engr. & Sys. Dev. Div.), "Fusion in Condensed Matter -

AUTHOR'S ABSTRACT

Consistent with a large body of experimental observations, a mechanism of fusion unique in condensed matter has been formulated with particular reference to deuterated palladium. The mechanism proposed brings to focus the relevance of electronic band structure of the host lattice to the cold fusion phenomenon and the crucial role strongly electro-negative elements like oxygen play therein. It is shown that direct interaction of oxygen with deuterated palladium, as happens in electrolysis experiments carried out in undivided cells, creates (through modification of electronic band structure of PdD_x) situations under which electrons of higher effective mass manifest. In the case of solid state experiments where oxide interface is present by design, an analogous situation is created at the onset of insulator-metal transition caused by the induced migration of deuterons through the layer. Screened by electrons of higher effective mass, deuterons in such situation undergo transition from bonded state to more stable quasimolecular state (D⁺D⁺)^{2e-} with substantially reduced (by a factor > 20) nuclear separation. Through quantum mechanical tunneling fusion takes place in such clusters with a probability of $10^{-1.5}$ s⁻¹ per pair - a value consistent with observed rates of excess heat production and near surface occurrence of the phenomenon. The model also identifies the root cause behind the observed sporadicity and irreproducibility of the phenomenon and indicates the features that are desired.

INDIA - RAPID LOADING OF H₂/D₂

A.B. Garg, R.K. Rout, M.Srinivasan, T.K. Sankaranarayanan, A. Shyam and L.V. Kulkarni (BARC), "Protocol for Controlled and Rapid Loading/Unloading of H₂/D₂ Gas from Self-Heated Palladium Wires to Trigger Nuclear Events," BARC "Cold Fusion Forum" on current research at BARC, June 22, 1995, p 1.

AUTHORS' ABSTRACT

It has now been established that during electrolysis of LiOD using Pd cathodes, a threshold loading ratio of at least 0.85 needs to be achieved before excess heat production can be expected. However for production of neutrons and tritium (and possibly charged particles and transmutation products, too) much lower D/Pd ratios, in the region of 0.4 to 0.7, appear to be adequate. This has independently been corroborated in a variety of gas loading experiments also. It is not so much the magnitude of the steady-state loading ratio that is attained, but rather the creation of non-equilibrium conditions which facilitates rapid migration / transport of deuterons within the Pd lattice (as demonstrated, for example, in Yamaguchi's experiments) that seems to be required.

With this in view, a systematic study has been undertaken using electrically self-heated 0.125 mm dia. Pd wires in H₂/D₂

atmosphere to optimize the conditions under which rapid loading/unloading of H₂ or D₂ can be achieved. It is found that the absorption rate is rapid if the wire temperature is set just below the knee of the loading ratio vs. temperature curve (~65°C for D₂ and ~115°C for H₂), while "instantaneous" desorption is achievable by switching the current (hence wire temperature) to an appropriate high value (>130°C for D₂ and >170°C for H₂). With this technique loading ratios of 0.6 ~ 0.7, close to the peak region of the resistance curve, have been achieved within about 5 ~ 10 minutes, in a reproducible manner, provided the wire surface is "suitably activated" prior to commencement. Gas pressures used in our studies to date have been < 4 bars.

The overall objective of the present study is to try and devise a simple experiment which can demonstrate "on demand", the occurrence of at least one anomalous nuclear phenomenon in a deuterated Pd lattice in a reproducible/repeatable manner.

INDIA - STRESS RELIEVING IN Pd FOILS

D. Mukherjee, A. Wordsworth (India), "Stress Relieving of Palladium Foils Controls its Electrocatalytic Properties," *Tool Alloy Steels*, 1994, vol 28, no 11, pp 323-325.

AUTHORS' ABSTRACT

The quenching of Pd foils makes it more electrocatalytic, in terms of electrochemical reactivity. This may be responsible for a higher degree of H removal, during the discharging process, by heating of the H-charged Pd-foils. Applications to the cold fusion process are indicated.

INDIA - LATTICE DYNAMICS

K.R. Rao and S.L. Chaplot (BARC, Solid State Phys. Div.), "Estimate of Cold Fusion Rates in Pd-D Lattices Based on Lattice Dynamics and Computer Experiments," BARC "Cold Fusion Forum" on current research at BARC, June 22, 1995, p 21.

AUTHORS' ABSTRACT

1) The rate R of any nuclear reaction is given by

$$R = n_{\alpha} n_{\beta} [\sigma(u)]_{\alpha\beta} = n_{\alpha} n_{\beta} \int \int f_{\alpha}(v_{\alpha}) f_{\beta}(v_{\beta}) \sigma(u) u dv_{\alpha} dv_{\beta} \quad (1)$$

where $n(\alpha/\beta)$ are nuclear densities, $f_{\alpha}(v_{\alpha})$ and $f_{\beta}(v_{\beta})$ normalised velocity distribution functions of velocities of α and β particles and u , the relative velocity of the particle α with respect to that of particle β . For low incident energies, the reaction cross-section (reaction rate per unit incident particle flux) is given by,

$$\sigma(u) = 2\pi x/u^2 \exp(-x/u) \quad (2)$$

where

$$x = [(2\pi z_{\alpha} z_{\beta} (e^2) / \hbar) = 2\pi z_{\alpha} z_{\beta} c / 137] \quad (3)$$

Here z_{α} and z_{β} are the charges of the interacting particles, \hbar is Plank's constant and c is the velocity of light.

The fusion cross section is given by

$$\sigma(\text{fusion}) = S_0 [\sigma(u_{\alpha\beta})] / E \quad (4)$$

assuming that it is a non-resonant charged particle reaction. $S_0 = 52.9$ keV.barn for D-D fusion.

2) The effective charge of the deuterons in Pd-D lattice can be arrived at by studying the lattice dynamics of the system using crystal potentials based on 'effective' ionic interactions specifically of the type,

$$V(r_{kk'}) = (e^2/4\pi\epsilon_0) (Z_k Z_{k'} / r_{kk'}) + a \exp\{-br_{kk'}/(R_k + R_{k'})\} \quad (5)$$

where $r_{kk'}$ is distance between a pair of atoms k and k' . Z_k and R_k are charge and radius of atom k . The potential parameters a and b are 1822 eV and 12.364 respectively. By comparing calculated phonon dispersion curves with those experimental data (of Rowe et al.) obtained by inelastic neutron scattering techniques, the charge and radius parameters Z_{Pd} , Z_D , R_{Pd} and R_D (that provide satisfactory phonon dispersion relation) have been determined to be equal to -0.3, +0.3, 1.95 Å and 0.22 Å, respectively.

3) Computer experiments were carried out using our software MOLDYN to integrate space-time trajectories of the atoms in the Pd-D lattices using the interatomic potential defined by lattice dynamical considerations as stated above. The PdD_{0.67} lattice is chosen on the basis of a regular FCC structure where D atoms are randomly located to result in the stoichiometry of interest.

The energy distribution of Pd and D atoms in Pd-D system is found to be a Maxwellian. The large energies associated with the tail of the Maxwellian are short-lived and are confined invariably with individual atoms. We find that these Short Lived Large Energy Fluctuations (SLEFs) relax in about 0.05 ps and frequency of occurrence may be taken to be inverse of the relaxation time.

4) The D-D fusion reactions in the solid arise from the SLEF atoms, $n_{\alpha} (= 10^{23}$ atoms/cc $\cdot f_{\text{slef}}$ where f_{slef} is frequency of slef events/sec/atom, namely $20 \cdot 10^{12}$ /sec/atom) acting as projectiles. The maximum energy associated with the atoms is such that the atoms will be stopped within a short range of at most 1 micron. Therefore, the number of target atoms that will be exposed to the incident slef atomic beam is $n_{\beta} = 10^{23}$ atoms/cc $\cdot t$ cms where t is the assumed thickness of the target. We have assumed $t = 1$ micron.

One has to integrate the fusion cross-section over the energy distribution of SLEF atoms and that of the target atoms, taking into account the velocity component of the latter along the projectile direction.

Based on considerations given above, one can evaluate the rate of fusion reactions, making use of a simple computer program.

We find that at 300K, assuming that the effective charge of deuterons is 0.3 e and that each deuteron, associated with a short-lived large energy fluctuation, has penetrability of less than 1 micron in the medium, the number fusion reactions is $0.7 \cdot 10^{17}/\text{cc}/\text{sec}$ of PdD or $0.6 \times 10^{12}/\text{cc}/\text{day}$ which is negligible compared to reported number of events in 'successful' cold fusion experiments. If the effective charge is allowed to vary, say, from 0.3e to 0.1e, the rate of fusion reactions would vary as given in Table below:

Effective charge Z(e)	No. of fusions/cc/sec
0.30	0.7×10^{17}
0.25	0.5×10^{15}
0.20	0.6×10^{16}
0.15	0.8×10^{16}
0.1	0.7×10^{25}

In other words, even for small changes in the effective charge from 0.3e to 0.25e, the rate increases from the negligible domain to about 1 per/cc/day. On this basis one can understand the sporadic and non-reproducibility of the phenomenon in some cases. However the rate can get modified due to dynamic screening effects. It is also possible that one event can trigger further avalanche of events.

INDIA - COLD FUSION FACTORS

M.K.S. Ray, R.D. Saini, D. Das, G. Chattopadhyay, R. Parthasarathy, S.P. Garg, R. Venkataramani, K.K. Kutty, D.N. Wagh, H.N. Bajpai, T.S. Iyengar, B.K. Sen, and C.S.P. Iyer (BARC), "An Investigation for Identification of Factors Governing F&P Phenomenon," BARC "Cold Fusion Forum" on current research at BARC, June 22, 1995, p 5.

AUTHORS' ABSTRACT

A series of experiments were carried out in divided electrolytic cells in an attempt to identify factors governing the occurrence of Fleischmann and Pons (F&P) phenomenon. Despite wide variation in operating parameters (type and concentration of electrolyte, current density, duration of electrolysis, temperature), use of cathodes varying in shape, size, metallurgical history and surface characteristics and perturbation of deuterated cathodes by sharp change in their temperature (both on-line and off-line), current density and impingement of ultrasonic pressure waves, experiments yielded no evidence of the phenomenon even though high loading (sometimes as high as D/Pd>2) could be achieved repeatedly. Large excess heat liberation, not accountable by any probable physico-chemical process, however, was observed

following perturbation of the state of equilibrium of a deuterated cathode (having a portion of it free of scale and bright in appearance) by air. Instances of anomalies in tritium distribution between gas and liquid phase resulting from such perturbation were also noticed. **These observations when analyzed in global perspective, clearly indicate the essentiality of oxygen and scale-free surface for occurrence of the phenomenon.** Study of desorption dynamics and related parameters revealed that the overall effect of oxygen is to enhance the escaping tendency of deuterium from Palladium lattice and that the phenomenon is in some way related to desorption. The significant increase in tritium activity in gas phase observed following repeated perturbation of deuterated cathode by induced pulsed magnetic is suggestive of a probable mechanism in which strong electron affinity of oxygen is of paramount importance.

INDIA - EFFECTS IN PROTON CONDUCTORS

M.K.S. Ray, S.P Garg, R. Venkataramani, R.D. Saini (BARC), "Investigations of Anomalous Effects in Proton Conductors - Current Program," BARC "Cold Fusion Forum" on current research at BARC, June 22, 1995, p 7.

AUTHORS' ABSTRACT

A clear understanding of the mechanisms involved in cold fusion, although is essential to acquire the ability to trigger the phenomenon at will and realize its full potential, is lacking at present. Our present endeavor hence is directed towards generation of correlated data that would help fill this gap. In the light of our earlier works in the field (i.e. 'An Investigation for Identification of Factors Governing F&P Phenomenon' and the follow up theoretical work 'Fusion in Condensed Matter - a Likely Scenario') the objective of our current studies can be viewed as an attempt towards experimental verification of the hypothesis that cold fusion is brought about by electrons of higher effective mass.

Candidate materials selected for the series of investigations planned are commonly known as proton conductors. These materials exhibit both electronic and ionic conductivity to a varying degree; some are metallic while others are semiconductors and insulators. Experiments are planned to be carried out using Na_xWO_3 , $x = 0.85-0.94$, K_xWO_3 , $x = 0.3-0.6$, $\text{SrCe}_{0.9}\text{Y}_{0.08}\text{Nb}_{0.02}\text{O}_{2.97}$ and LaAlO_3 primarily because (1) unlike in Pd, Ti etc. where absorbed hydrogen ordinarily remain in bonded state and have less mobility, in protonic conductors they are present as ions and are highly mobile, thereby meeting the conditions essential for any substantive mutual interactions (2) by altering the stoichiometry of alkali metals and their replacement by hydrogen in tungsten bronzes and by changing temperature and concentrations of hydrogen in proton conductors, their conductivity could be varied over a very wide range inclusive of the region where electrons of higher effective mass are known to manifest and hence expected to permit verification of the

hypothesis (3) neutron emission and excess heat liberation have been observed in all the above mentioned materials with a fair degree of reproducibility and therefore most suitable for the study objective.

Experiments with some of the proton conductors already prepared are expected to commence soon.

INDIA - LUMINESCENT PHENOMENA

R.K. Rout, A.B. Garg, M. Srinivasan and A. Shyam (BARC, Neutron Physics Div.), "Observations of a Strange Luminescence Type Phenomena in Palladium Hydride," BARC "Cold Fusion Forum" on current research at BARC, June 22, 1995, p 2.

AUTHORS' ABSTRACT

Reproducible anomalous emissions have been observed [1,2] from palladium samples loaded or reloaded either with hydrogen or deuterium. The samples used for loading are in the form of a planchet, foil or wire. The emissions are detected by autoradiography using medical X-ray film and by CaSO₄ based TLD's. The loaded samples fail to trigger any signal in solid state based detectors or even low threshold gas flow detectors. **However, the emissions seem to occur only in the presence of oxygen.** The fogging of X-ray film does not show much variation with hydrogen or deuterium loading. The intensity of fogging increases with applied field of either polarity. In a recent study with loaded palladium wires where atomic loading ratio (H or D/Pd) is ascertained through increase in wire resistance, the emissions were found to pass through a stack of ten papers of white (80 mg/cm²), yellow (74 mg/cm²) or black (60 mg/cm²) color or thin sheet of plastic (25 mg/cm²) but not through very thin sheets of aluminized mylar (0.3 mg/cm²), glass (20 mg/cm²), quartz (200 mg/cm²), beryllium foil (1.5 mg/cm²) or palladium foil (35 mg/cm²). The contact image on the X-ray film shows absence of fogging just below the wire but there is intense halo-type fogging on either side. The wire once loaded (0.6 to 0.7 H/Pd) continues to fog the film even after 20 days though with reduced intensity.

The wires were initially examined for any inherent radioactivity before loading with hydrogen. The sensitivity of the X-ray film was checked for pressure effect, thermal effect from electricity heated (at $\approx 60^\circ\text{C}$) Pd, Ni or Cu wires and for any contamination in the hydrogen or deuterium gas used. The analyses of the observed phenomena seems to suggest that the radiation consists of low energy (a few to a few 10s of eV) charged particles. Further studies are in progress to understand the origin of these emissions.

- 1) R.K. Rout et al., *Indian J. Tech.*, 29, 571, 1991.
- 2) R.K. Rout et al., *Indian J. Tech.*, 31, 551, 1993.

INDIA - TRITIUM IN SOLID CF TARGETS

R.K. Rout, R.K. Samant, A. Sinha and M. Srinivasan (BARC), "Measurement and Imaging of Tritium in Solid Cold Fusion Targets: Our Experience So Far," BARC "Cold Fusion Forum" on current research at BARC, June 22, 1995, p 18.

AUTHORS' ABSTRACT

Tritium is often reported to be one of the products in cold fusion experiments. Tritium can be measured directly by detecting its decay product 'betas' (18 keV peak energy) or from the characteristic X-rays resulting from the interaction of these betas with the atoms of the host metal lattice (in case of solid samples). It is found that a low background (in our case it is ≤ 14 cpm) windowless gas flow beta counter is the most efficient technique to detect the presence of tritium in small ($< 2\text{mm}$ thick, $< 20\text{mm}$ dia.) solid samples, while a graphite anode ion chamber is ideally suited for samples with tritium levels exceeding tens of kBq.

Autoradiography with X-ray film is a very useful technique to map tritium emitting zones in solid samples. The advantage of this method is that the low activity of the samples can be integrated for a longer time without any electronic noise interference to produce a clear image. The characteristic X-rays of the host material excited by tritium betas can be advantageously utilized to indicate the presence of tritium in low Z samples such as titanium employing detectors like thin NaI scintillator unit (1mm thick crystal with 125 μm Be window) or a thin window Ge-Li set-up (10mm thick detector with 75 μm Be window). We have recently carried out some studies with a 'storage phosphor plate' system to image tritium in solid samples. Suitable scintillator coupled to image intensifier and image processing unit is under active experimentation to detect tritium in solids. A companion paper by Amar Sinar et al. in this Seminar, discusses use of such an image intensifier based system for measurement and imaging of tritium in solid cold fusion targets.

INDIA - TRITIUM GENERATION

T.K. Sankaranarayanan, M. Srinivasan, M.B. Bajpai & D.S. Gupta (BARC), "Evidence for Tritium Generation in Self-Heated Nickel Wires Subjected to Hydrogen Gas Absorption/Desorption Cycles," BARC "Cold Fusion Forum" on current research at BARC, June 22, 1995, p 3.

AUTHORS' ABSTRACT

A program to study hydrogen gas loaded nickel samples was initiated following reports of observation of anomalous excess heat in such systems by Focardi et al. of Italy in early 1994 (referred to as Piantelli experiment). Nickel samples were in the form of electrically heated wires (0.125 mm or 0.38 mm dia. x 500 mm length) coiled as a spring. The Ni spring was suspended

inside a glass "cell" connected to a vacuum unit and gas handling system provided with a sensitive manometer for differential pressure measurements and could be heated electrically through tungsten leads. The lower part of the cell had an outer jacket through which coolant water could be passed for calorimetric measurements.

For outgassing/unloading H_2 gas, the wire was raised to a temperature above the curie point under a vacuum of 10^{-5} cm of Hg. For loading, Iolar grade H^2 gas was introduced into the cell at subatmospheric pressure. After several trial runs an appropriate protocol for activating the Ni surface and obtaining maximum rate of absorption and desorption was established. Repeated cycles of loading/partial unloading were carried out to increase the net absorption of H_2 into the wire.

At the end of the loading runs, the wires were cut into 3 or 4 pieces and dissolved separately in 5 ml of dilute HNO_3 . After-neutralization of excess acid the solutions were vacuum distilled prior to liquid scintillation counting for determination of tritium content. **So far 6 out of 9 loaded wires have indicated generation of tritium.** However not all the cut pieces from a given wire have shown tritium, suggesting that tritium production is non-uniform over the length of the wire. For example, out of 27 cut pieces which have been dissolved and counted up to now, only 14 pieces have shown tritium, in the range of 3 to 2300 Bq. The maximum amount of tritium production, namely 2300 Bq, was observed in one 11 cm segment of a 45 cm long wire which displayed exceptional absorption/desorption characteristics. Blank (or control) samples cut from the two nickel stock spools dissolved and counted following an identical procedure have not given any counts above background levels.

Calorimetric measurements carried out to date during loading/unloading cycles with some of the wires, have not revealed any anomalous heat generation.

INDIA - DEAD TIME FILTERING

A. Shyam, M. Srinivasan, T.C. Kaushik and L.V. Kulkarni (Neut. Phys. Div., BARC), "During Electrolysis of Heavy Water with Palladium Cathode Using the Dead Time Filtering Technique," BARC "Cold Fusion Forum" on current research at BARC, June 22, 1995, p 4.

AUTHORS' ABSTRACT

Experiments were conducted to detect neutron bursts during the electrolysis of D_2O ($LiOD$) and H_2O ($LiOH$) using tubular palladium cathodes (area $\sim 300\text{cm}^2$) and nickel anode cell (Milton Roy) at low current densities (20 to 65 mA/cm^2). Data was acquired for 2 months, of which 15 days each were devoted to "control" experiments before and after the D_2O run.

The annular neutron detection system comprised of a bank of 16 BF_3 tubes embedded in a polyethylene cylindrical thermalising assembly in which an instantaneous neutron burst is temporally stretched to a few tens of μs duration. The electrolytic cell was placed at the center of this assembly. The preamplifiers and detector connections were specially designed so as to be electromagnetically and hermetically sealed. It was confirmed that the set-up did not give spurious counts even under the high humidity conditions of the Bombay monsoon season. The overall neutron detection efficiency of the system was 10% with a background of $0.049 + 0.002$ counts/s over a 15 day period.

The direct and dead time (100 μs) filtered train of pulses was continuously counted in 5 second intervals and the data recorded on a personal computer. The total neutron counts per day with the D_2O cell were found to be consistently about 9% above the background. A significant observation emerged from the frequency distribution of 5 sec counts which was close to Poisson in case of background but contained several large multiplicity events in presence of the H_2O and D_2O cells implying the emission of bursts of 20 to 100 neutrons in $<100 \mu\text{s}$ duration from the latter.

The feature is more evident from the multiplicity distribution of the data obtained after subtracting the dead time filtered counts from the unfiltered counts. While the background counts did not show even a single triplet or higher multiplicity count throughout the 15 day period, there were up to 6 and 7 counts in some 100 μs intervals in presence of H_2O or D_2O cells. The burst events were however very few, average value being 1.7, 3.8 and 7.6 bursts per day for the cases of background, H_2O cell and D_2O cell respectively.

INDIA - FARADAIC EFFICIENCY

Anurag Shyam and Amar Sinha (Neut. Phys. Div., BARC), "Faradaic Efficiency in Open Electrolysis Cells," BARC "Cold Fusion Forum" on current research at BARC, June 22, 1995, p 10.

AUTHORS' ABSTRACT

Experiments have been conducted to measure faradaic efficiency (E_f) in open cells having typical characteristics of cells employed in light/heavy water excess heat experiments. The cells' anodes were made from Pt wire (200 μm diameter) spirally wound around the cathodes which were rectangular shaped Pd or Ni foils (0.5 to 2 mm thick). The spacing between the cathode and the anode was maintained by PTFE frames, to ~ 3 min. Typically ~ 200 ml of 0.57M solutions of K_2CO_3 , Na_2CO_3 or saturated solutions of $LiOH$ in natural water were used as electrolytes. The current density was varied from 1 to 600 mA/cm^2 . E_f was estimated from the rate of evolution of electrolytic gases from the cells using the burette method.

At the beginning of electrolysis, the cells with Ni electrodes had ~100% E_f . On the other hand, cells with Pd electrodes had very low E_f (due to H_2 loading). The cells took a day to stabilize, after which a constant average value of E_f was obtained. However, short duration fluctuations of E_f , varying from 0 to 100%, were observed even after stabilization. For all cells E_f was < 100%. It increased with the rise of current density. The cells with Ni electrodes and CO_3 -ions had lower E_f as compared to cells with Pd electrodes and OH-ions. The cells with K_2CO_3 electrolyte had lower E_f as compared to Na_2CO_3 .

The E_f was found to be sensitive to metallic and organic impurities. Addition of copper (a 0.1 ml freshly machined metallic piece dropped into the cell) significantly reduced E_f . On the other hand addition of a piece of iron increased the E_f close to 100%. Some organic matter (for example few drops of soap solution, derived from organic oils) also increased E_f to ~100%.

There could be many reasons for E_f to be < 100%. For example, since oxygen dissolves in electrolytes, this oxygenated electrolyte coming in contact with Pd or Ni electrodes may catalytically recombine with H_2 adsorbed by them. In the typical cells employed for 'cold fusion' experiments the electrodes are often close to each other; therefore gas from one electrode can reach the other electrode and catalytically recombine with the gas generated at that electrode (Pd, Pt or Ni).

It was also observed that with alternating current (AC), the cells could conduct via a non-electrolytic mode ($E_f=0$) mode. The contribution of this mode enhances with the increase of frequency. Therefore, for pulsed electrolysis, reduction in duty cycle (increase of pulsing frequency) results in decrease of E_f .

INDIA - PARTICLE SCINTILLATION DETECTION

Amar Sinha, B.D. Bhawe, C.G. Panchal, A. Shyam and M. Srinivasan (Neut. Phys. Div., BARC), "Detection of Individual Nuclear Particle Scintillations using Image Intensifier Tubes: Possible Applications in Cold Fusion Experiments," BARC "Cold Fusion Forum" on current research at BARC, June 22, 1995, p 19.

AUTHORS' ABSTRACT

A novel technique of imaging individual nuclear particle scintillations using image intensifier tubes has been developed. One of the most attractive features of the technique of nuclear scintillation imaging is the ability to view directly individual nuclear particle scintillations using a 3 volt dry cell operated portable image intensifier tube of gain typically 15,000 or more. These images can also be coupled to a CCD camera for direct viewing on a video monitor and digitized and processed using frame grabber and processor PC add-on cards. Using this technique we have carried out position sensitive detection of

alphas, thermal and fast neutrons, X-ray and gamma photons and betas using different scintillators.

The development of this technique was particularly initiated for cold fusion related applications but subsequently it was found useful for many other applications also. Its development for cold fusion applications was started for the following reasons. It is generally known that emissions of radiation from deuterated metallic samples are sporadic in nature and of small intensity. Measurements of such radiation using conventional electronic detectors based on pulse counting always raises the doubt of electronic noise. Secondly, several experiments have indicated that anomalous emission of nuclear radiation probably occurs from some isolated spots and not uniformly throughout the surface of the deuterated metals such as palladium or titanium. Establishing a correlation between the metallurgical property at a certain spot in the metal surface and emission of radiation may be crucial to unraveling the mystery of cold fusion. In this context, the development of a high resolution position sensitive nuclear scintillation imaging system being developed by us can play an important role in correlating the material characteristics and anomalous emission of nuclear radiation in cold fusion phenomenon. In this talk we present details of the experimental system as well as some preliminary results and discuss its application in the context of cold fusion.

INDIA - SEARCH SEEDS FOR TRANSMUTATION

M. Srinivasan, N.K. Ramaswamy, R.N. Khandekar, A.B. Patwardhan, R. Sundaresan et al. (BARC), "Search for Evidence of Transmutation of Elements during Germination of Seeds (Kervran Effect)," BARC "Cold Fusion Forum" on current research at BARC, June 22, 1995, p 20.

AUTHORS' ABSTRACT

A number of experimentalists have, over the last 150 years, reported obtaining evidence which seems to indicate that the content of trace elements such as Na, K, Mg, Ca, etc. of certain biological specimens changes with time suggesting the occurrence of nuclear transmutation reactions in nature. Louis Kervran of France first documented these studies systematically in his famous book Biological Transmutations published in 1962. Kervran's third book in the series titled Low Energy Transmutations includes apparent evidence of occurrence of nuclear reaction in non-living (geological) matter also. An English translation of this book has recently been prepared by the Library and Information Services Division of BARC (BARC-Tr-94-95). All this work was done decades before the appearance of the cold fusion phenomenon!

Among the various studies described by Kervran is a very simple experiment which lends itself to easy verification. This is the so called 'germinating seeds' experiment. Kervran has reported that when certain seeds germinate there is an increase or decrease in

the content of trace elements such as Na, K, Mg, Ca, etc. **The transmutation appears to involve addition or removal of either a hydrogen nucleus (${}^1\text{H}^1$) or an oxygen nucleus (${}^8\text{O}^{16}$ for example) or a carbon nucleus (${}^6\text{C}^{12}$) from the trace elements.** In the experiments cited by Kervran, great care was taken to ensure that there was no external input (contamination) of trace elements into the system. Only distilled water was used to water the plants. The plants were grown in a clean room with filtered air. The possibility of leaching of trace elements from the petri dish was carefully studied and eliminated.

During 1992-93 similar studies were carried out in BARC. Green gram seeds (5.0 grams per lot) were grown for 6 days. Ashing of the plants and seeds as well as their analysis was done by persons experienced in trace element analysis (for environmental samples). Both atomic absorption as well as spectroscopic techniques were used to determine trace element content. The results of these preliminary experiments will be discussed during the Seminar. A new series of experiments has been initialized in June 1995.

INDIA - EXCESS HEAT IN $\text{SrCeO}_3:\text{YNb}$

R. Sundaresan and S.N. Vaidya (Anal. Chem. & Chem. Div., BARC), "Proposed Experiment for Confirmation of Excess Heat in $\text{SrCeO}_3:\text{YNb}$ in Presence of Deuterium," BARC "Cold Fusion Forum" on current research at BARC, June 22, 1995, p 8.

AUTHORS' ABSTRACT

An experiment is being set up to detect, by means of Differential Thermal Analysis, production of excess heat in $\text{SrCeO}_3:\text{YNb}$ in deuterium atmosphere above 380°C . The specimen and reference material, in the form of thin pellets, are placed in pyrophyllite holders in a cylindrical stainless steel chamber having provision for introducing deuterium (or any required gas) and electrical probes. The region of the chamber containing the specimen and reference materials is located in the uniform temperature zone of a vertical furnace and heat absorption or production is detected by differential heat measurement.

The compound $\text{SrCe}_{0.9}\text{Y}_{0.8}\text{Nb}_{0.02}\text{O}_{2.97}$ was prepared from a stoichiometric mixture of the powders of SrCO_3 , CeO_2 , Nb_2O_5 and Y_2O_3 by solid state reaction at 940°C . The synthesized material was characterized by XRD.

The experimental set up for hydrogen/deuterium absorption and desorption studies is available in the Chemistry Division where it has been extensively used for studies on metal hydrides. This facility is proposed to be utilized for experiments on D_xSrCeO_3 system.

INDIA - MICROSECOND CURRENT PULSING

R.Sundaresan (Anal. Chem. Div., BARC), "Effect of Microsecond Current Pulsing on Excess Power Generation during Electrolysis of LiOD ," BARC "Cold Fusion Forum" on current research at BARC, June 22, 1995, p 9.

AUTHOR'S ABSTRACT

A pulser which can superimpose a d.c. pulse of about 40 volts on a steady (charging) current has been fabricated. The pulse width can be varied between 1 and $20\ \mu\text{s}$ and the inter-pulse time gap between 30 and $1000\ \mu\text{s}$. After charging the palladium cathode with deuterium at low currents of $< 100\ \text{mA}$ such that the D/Pd ratios reached 0.85 or higher, the pulsing current was turned on. The effect of varying pulser settings on (a) D/Pd ratio, (b) activity of tritium in the electrolyte and (c) the electrolyte temperature was studied. The D/Pd ratio remained the same during pulsing and there was no tritium generated in the electrolyte. However the temperature of the electrolyte, showed a marked rise in a short time when the pulse widths were 10 and $20\ \mu\text{s}$. More experiments are now planned to investigate this excess heat manifestation, taking into account the precise values of the current and voltage during pulsing and any possible spurious heating effects due to μs -pulsing.

INDIA - LOADING TRITIATED HYDROGEN

S.G. Talnikar, A. Ramanujam and N. Venkatraman (Fuel Reproc. Div., BARC), "Electrolytic Loading of Tritiated Hydrogen in Metal Wire Cathodes," BARC "Cold Fusion Forum" on current research at BARC, June 22, 1995, p 17.

AUTHORS' ABSTRACT

Experiments are underway to load tritiated hydrogen in different metallic wires like Pd, Ni, etc. by electrolytic technique. Initially Pd wires (0.125 mm dia and $\sim 1\ \text{cm}$ long) were loaded with hydrogen by electrolyzing 1M KOH solution. The Pd wire was made as cathode while Pt wire was used as anode. Amount of hydrogen loaded in Pd was inferred from the increase in resistance of the wire. The resistance of the wire which was $\sim 1.0\ \text{ohm}$ initially increased to a maximum value of $\sim 1.5\ \text{ohms}$ corresponding to a H/Pd loading ratio ~ 0.45 . Current density was varied from $100\ \text{mA}/\text{cm}^2$ to $1000\ \text{mA}/\text{cm}^2$ in these experiments.

A new electrolysis cell has now been fabricated in which five cathode wires can simultaneously be loaded under the same experimental conditions. A few experiments were done by taking $10\ \mu\text{C}$ per 60 ml of tritium activity as tracer, in 1M KOH solution. Electrolysis was carried out using Pd, Ti, Ni and Zircaloy wires as cathodes using a current of about 300 mA, for more than 24 hours. Radiometric assay of the wires however, indicated some alpha contamination. It is suspected that the alpha activity is probably caused by cross contamination arising in the FRD

control laboratory, wherein considerable quantities of Pu samples are routinely handled. The experiments have since been repeated at a low background laboratory. As the preliminary results indicate no gross alpha contamination, electrolysis with tritiated solutions has been resumed.

The objective of these experiments is two-fold: (a) To produce wire samples of various metals containing known quantities of tritium, needed for developing reliable non-destructive techniques of measuring and imaging tritium in metallic cold fusion samples. (See companion paper by Rout et al. in this Seminar) (b) The second and more important objective is to use tritium as a tracer and ascertain whether, during electrolytic loading, the hydrogen (and tritium) tends to accumulate in preferred locations in the solid state lattice forming "hot spots". Using advanced imaging techniques, it is proposed to obtain information on this type of behavior.

INDIA - SCREENING & NUCLEAR REACTIONS

S.N. Vaidya (Chem. Div., BARC), "Deuteron Screening, Nuclear Reactions in Solids and Superconductivity," BARC "Cold Fusion Forum" on current research at BARC, June 22, 1995, p 12.

AUTHOR'S ABSTRACT

Screening of Coulomb interactions by itinerant deuterons contributes to the enhancement of d-d reaction rate in some metal deuterides and fast deuteron conductors such as PdD_x, D_yNa_xWO₃, SrCeO₃:YNb, etc. We propose that the deuteron screening mechanism also gives rise to the anomalous isotope effect in PdD(H) system and to increase in T_c of D_xYBa₂Cu₃O_{7-δ}. In conjunction with the presently known factors that govern superconductivity, the deuteron screening might lead to a new class of superconductors.

JAPAN - HYDROGEN PRESSURE AT CATHODE

M. Enyo (Catalysis Res. Cent., Hokkaido Univ., Sapporo), "The Effective Hydrogen Pressure at Cathode as a Key Concept in Hydrogen Adsorption and Absorption Phenomena," *Proc. Electrochem. Soc.*, 1994, vol 94-21 (Electrochem. and Matls. Sci. of Cathodic H. Adsorp. & Absorp.), pp 75-91.

AUTHOR'S ABSTRACT

The relation between the surface coverage with adsorbed hydrogen and its activity is discussed. Driving force of hydrogen entry into hydrogen evolving cathode may be the activity or the equivalent effective hydrogen pressure. The latter frequently deviates from a Nernst-type equation that involves hydrogen overpotential directly. The cause of deviation is explained as that the pressure is related to the reaction intermediate of the hydrogen evolution reaction, namely, hydrogen adatom, and hence its

activity is kinetics dependent. The effective pressure is quantitatively analyzed from the mixed rate-control model developed earlier. Analysis is extended to interpret experimental observations such as the relation between hydrogen permeation rate and current density of polarization, the effects of catalytic poisons on the effective hydrogen pressure, etc. Mechanism of cathodic hydrogenation reduction of unsaturated organic substances may be discussed on the same basis.

JAPAN - NICKEL HYDROGEN SYSTEM

Hideo Kozima (Fac. Sci., Shizuoka Univ.), "On Cold Fusion in a Ni-H System," *"Cold Fusion"*, 1995, no 8, pp 5-7.

AUTHOR'S ABSTRACT

The problem of excess heat production in a Ni-H system was investigated according to the trapped neutron catalyzed fusion model. Explanations of experimentally observed amounts of excess energy are given.

JAPAN - COLD FUSION STATUS

Keiji Kunimatsu (Imura Japan K.K.), "Current Status of Room-Temperature Nuclear Fusion. Excess Heat Measurement," *Petrotech (Tokyo)*, 1994, vol 17, no 12, pp 998-1003, 12 refs, in Japanese.

AUTHOR'S ABSTRACT

A review is given on measurement of excess heat related to cold fusion using an electrolytic method comprising open-type heavy water electrolysis, built-in catalyst type heavy water electrolysis, and fuel cell type heavy water electrolysis.

JAPAN - SOLID-STATE ELECTROCHEMISTRY

O. Yamamoto (Dept. Chem., Mie Univ.), "Applications (of Solid State Electrochemistry)," *Chem. Solid State Mater.*, 1995, vol 5 (Solid State Electrochem.), pp 292-332.

AUTHOR'S ABSTRACT

A review with many references is given. The basic principles of several major applications for solid electrolytes and insertion compounds, namely batteries, fuel cells, chemical sensors, electrochemical memory devices and electrochromic displays, are discussed.

JAPAN - PATENTS GRANTED

Chemical Abstracts, vol 122

JP 07 77,588; "Electrodes for cold nuclear fusion," Harunori Doke (Doke Masaaki), 20 March 1995, appl 91/173,485, 16 April 1991; 4 pp. A porous spongy electrode is prepared by putting a large number of fine particles of Pd or Ti in an electrode-shaped mold, heating with compression using radiofrequency or electromagnetism to make it undergo semi-fusion. The electrode is mechanically vibrated at high speeds to increase the reaction rate. The electrode area is increased from 10- to 10,000-fold, and the probability of the nuclear collision is increased $2\pi f$ -fold (f = cycle no. vibration).

EP 645,777; "Cold nuclear fusion apparatus," Toichi Chikuma, 29 Mar 1995, JP appl. 93/260,463, 27 Sep 1993; 18 pp. A cold nuclear fusion apparatus which is high in common value is described, where the screening effect and a cooperative phenomenon are enhanced for a substance undergoing nuclear fusion after being occluded into an occlusion member to promote a nuclear fusion reaction and the time, the magnitude, etc. of the occurrence of nuclear fusion can be controlled. An excitation apparatus for promoting nuclear fusion of a substance occluded in a reactor in a reaction vessel from the outside is provided in close contact with a portion of the reactor. The excitation apparatus includes a battery, a magnetic flux generator, a heating unit, an ultrasonic wave generator, a laser light irradiation apparatus and a high-voltage discharge apparatus. Also, a confinement apparatus for preventing the substance, occluded in the occlusion member and undergoing fusion, from escaping to the outside of the occlusion member is provided.

JP 07 43,484; "Radioactive Solid Heat-Generating Elements," Takashi Namura (Matsushita Electric Ind. Co. Ltd.), 14 Feb. 1995, appl. 93/184,773, 27 Jul 1993; 4 pp. The solid has the high absorptivity of a light element and is made of a radioactive element. The solid is composed of a laminate of a layer comprising mainly a radioactive element and another layer. A small, economical, and safe solid heating element can be manufactured.

MOLDOVA - COMMERCIALIZED HEATING DEVICE

Chris Tinsley (Nottingham, UK), "Water Fuel Device Conquers the Marketplace!" *Infinite Energy*, vol 1, no 2, May/June 95, pp 33-37.

SUMMARY

A trip to Moldova by two cold fusion correspondents shows a very successful commercial venture involving heater units functioning by what appears to be over-unity effects. Chris Tinsley, a science reporter from the UK was met in Budapest by Dr. Peter Glück, and from there they continued on train to Kishinev in Moldova, just northwest of Romania.

Being foreshadowed by many rumors of its existence, the Moldovan micro-cavitation water heater (Yusmar) was formally confirmed at ICCF5 this spring. It is being sold in the Commonwealth of Independent States (CIS) by the VIZOR company in Kishinev, and the demand is high. Dr. Glück had visited their offices before and had reported back that it was a thriving company and that the device, on which he had conducted preliminary tests, was over-unity.

During this visit, Tinsley and Glück were able to spend much of the day with the scientist who had invented and developed the Yusmar device, Dr. Yuri S. Potapov. He showed them the facilities, encouraged them to test the units, and allowed full filming and photography of the excursion. The factory is an obvious commercial success, with a large volume of production of the heating units. The machine comes in 4 sizes, from single apartment size to the large 3-M and 4-M units that are suitable for heating hotels or factories.

There were customers at the factory, all of whom were pleased with the units and wanting to buy more. A group of Orthodox clergy from a nearby monastery told at length of the great savings they had since heating with these machines. Dr. Potapov was going to install another, larger machine in the monastery, at no charge to the monks, that would heat the monks' cells in addition to the hot water they currently had. The enthusiastic staff at the factory, in addition to providing technical information, told us that Dr. Potapov significantly sponsors many Moldovan cultural and artistic endeavors as well.

In the Yusmar unit itself, a vortex is established in the liquid in the tube. The velocity gradient within the liquid is so great that cavitation occurs -- not between the liquid and the tube walls, but between adjacent layers of liquid -- a difference between it and the Griggs Hydrosonic pump. Tests in Belarus have suggested Coefficients of Performance (COP) to be as high as 10, that is ten times as much heat produced as energy taken in by the motor. But various tests are showing a great variation in COP, apparently resulting from different parameters of use. Performance depends critically on variable factors -- liquid viscosity, flow rate, and such. Test starting shortly in the USA will provide a more substantial set of performance curves, showing the effects of the variables on COP.

Despite the well-known "no experimental results can be accepted without theoretical confirmation," the commercial reality is that even without scientific knowledge of every part of its functioning, the units are selling, making a decent profit, and customers are satisfied enough to repeatedly buy more units. And this in a country still struggling with economic recovery, where market forces are very attuned to using money wisely. "Heretical as it may be to suggest this, there ARE other means than the purely scientific for the assessment of reality."

[Note: Three different organizations in the U.S. have tested imported devices with no COP greater than 1. -Ed.]

FIRST YUSMAR TESTS IN U.S.

Scott Little, H.E. Puthoff (EarthTech Intl.), "Preliminary Test Results on the Potapov Device," pre-print from authors.

Introduction

A water-heating device developed in Kishinev, Moldavia by Dr. Yu.S. Potapov has been reported to produce a heat output up to 3 times greater than the energy required to drive it. A Russian physicist, Lev G. Sapogin, has offered a theory to explain this phenomena in his paper entitled "On One of Energy Generation Mechanism in Unitary Quantum Theory." We obtained a Potapov device and conducted a series of energy balance measurements on it. No evidence of over-unity performance was observed.

Apparatus

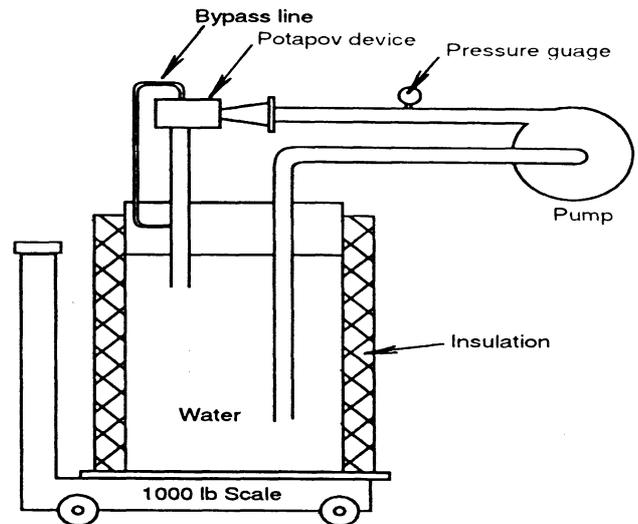
The device we tested is known as a YUSMAR-2 to the manufacturer. Apparently, these devices are enjoying some acceptance in Russia as building heaters and the YUSMAR-2 is the second in a line of four models that they make. For this model, the manufacturer specifies an inlet pressure heat of 50 meters of water (71 psi) and a flow rate range of 12.5-23 cubic meters per hour (55-101 gpm).

The device we tested consists of a largely cylindrical chamber with a tangential inlet that spirals gradually into the cylindrical body of the chamber. There is a main axial outlet that occupies most of one end of the chamber and a secondary, smaller axial outlet on the other end of the chamber. The chamber is 2.5" in diameter and 1" high. The inlet port is rectangular, 1" high and 0.6" wide. The main outlet is 2" in diameter. The secondary outlet is about 3/8" in diameter. Outside the chamber, the inlet pipe is a cone which tapers from 2" pipe down to the rectangular inlet over a distance of 5". The main axial outlet immediately opens into a 24" long section of 2" pipe.

As shown in the figure below, the device is mounted directly above a steel 55 gallon barrel. The exit pipe from the device was extended with 2" PVC pipe and a "no-hub" coupling to a total length of 38" of which approximately 4" is below the water level. The discharge was placed below the water level to prevent air entrainment in the suction pipe. The bypass line connects the secondary outlet to the main exit pipe. This line appears to be an optional feature of the Potapov device. In the literature accompanying our YUSMAR-2, the bypass line is not shown. However, in a photograph we obtained which shows a device similar in size to the YUSMAR-2, the bypass line is clearly present. We conducted tests with and without this line.

The inlet of the Potapov device is connected directly to the discharge of a 7.5 hp centrifugal pump with a straight 1.5" pipe (discharge port size) 16" in length. 2" PVC piping was used for the suction tube. The total lift in the suction line is about 22". In this configuration, the pump achieves a head pressure of about 60 psi (indicated with a cheap pressure gauge in the discharge line) and a flow rate of about 106 gpm (measured by letting the

pump empty the 55 gallon barrel and measuring the fall rate of



the water level).

The electrical supply to 7.5 hp pump motor passes through a General Electric 3-phase watthour meter to permit measurement of the electrical energy consumed. This meter has a K of 10.8 which means that the wheel rotates once for every 10.8 watt hours (38,880 joules) delivered to the load.

A small immersible pump (not shown in the figure) is used briefly when starting the system to prime the main pump.

The barrel was wrapped with 3.5" thick R-11 insulation batting and is situated on the platform of a 1000 lb. scale so the water can be weighed.

A high-accuracy glass thermometer (partial immersion type) with 0.1 degree Centigrade graduations is used to measure the temperature of the water in the barrel.

Test Procedure

The energy balance measurements were conducted by running the main pump for a certain period and measuring both the electrical energy consumed by the pump motor and the heat energy delivered to the water during that period.

Prior to starting the test, the 55 gallon barrel was filled with ordinary tap water to within about 8" of the top and weighed (the empty weight of the barrel is known).

Before starting the test, the main pump was operated briefly in order to bring the rotating wheel in the watthour meter around so the index mark was centered in the viewing port.

Before starting the pump, the water in the barrel was stirred vigorously with a large wooden paddle and a temperature reading was taken by immersing the glass thermometer to the proper

depth and waiting until the mercury appeared to be perfectly stationary for at least 30 seconds (i.e. had stopped moving).

To start the main pump, the small priming pump was operated for about 1 minute to fill the piping system and the main pump. Then the main pump was started and the priming pump stopped within a few seconds. While the main pump was operating, revolutions of the watt-hour meter wheel were counted.

The main pump was stopped precisely when a certain number of wheel rotations had been completed and the index mark was again centered in the viewing port on the front of the watt-hour meter.

Immediately after stopping the main pump, the water in the barrel was stirred with the wooden paddle and another temperature reading was taken in the same manner.

Results

	Test 1	Test 2	Test 3
starting water temp	25.60	29.60	25.95
ending water temp	29.65	33.90	27.90
water wt. (lb.)	366.5	366.5	341.5
wheel revolutions	100	100	40
bypass line	absent	present	present
energy input (Mj)	3.89	3.89	1.56
energy output (Mj)	3.03	2.99	1.27
over efficiency*	0.78	0.77	0.81

*see motor efficiency discussion below

Air temperature in our laboratory is typically around 27°C. In test 3, an effort was made to conduct the test over a temperature range that would minimize heat losses to the air (i.e. the water was warmed from slightly below air temperature to slightly above air temperature). Presumably, this is why the efficiency in test 3 is a few points higher than in tests 1 and 2.

Test 2 was conducted about 1 hour after test 1, using the same water. Note that the water temperature fell only 0.35 degrees during that hour.

The pump run in Test 2 was timed at 727 seconds. This time allows the calculation of the average power consumption of the pump motor: 5.35 kW. The motor manufacturer provided a load curve for this motor which indicates that under this loading the motor should be 85% efficient (the efficiency vs. load curve is very flat in this loading region).

Error Discussion

The errors associated with each of the critical measurements have been estimated as follows:

delta-T	0.05 °C (2.5% relative in test 3)
water weight	2 lbs. (about .5% relative)
watthours	.5% relative

These errors are independent and would thus combine to produce an overall expected error of about 2.6% relative.

Conclusions

The Potapov device we tested did not show any evidence of over-unity performance in our tests. The observed efficiency is 4-8% lower than the rated motor efficiency. This difference is significant and is probably due to heat losses to the air and to the body of the pump, which were not measured in these tests.

Our test conditions closely matched the manufacturer's recommended operating conditions for the YUSMAR-2. Our head pressure was about 60 psi instead of the recommended 71 psi but our 106 gpm flow rate was at the high end of the recommended range (55-101 gpm). It therefore does not seem likely that we were "underfeeding" the device.

We can find no explanation for the failure of this Potapov device to perform as reported (300% efficiency). (It is of course possible in principle that we have failed to meet some operating condition that is critical for the over unity performance.) We welcome suggestions for further testing. [Was the water cavitating at the temperatures used in these tests? -Ed.]

RUSSIA - EXTERNAL NEUTRON FLUX

Chemical Abstracts, vol 122

A.G. Lipson, D.M. Sakov (Inst. Fiz. Khim., Moscow), "Increasing the Intensity of an External Neutron Flux during Irradiation of a KD_2PO_4 Crystal in the Moment of a Ferroelectric Transition," *Pis'ma Zh. Tekh. Fiz.*, 1994, vol 20, no 23, pp 46-52, in Russian.

AUTHORS' ABSTRACT

Experiments were conducted on the irradiation by an external neutron source of deuterated samples of KD_2PO_4 possessing inherent emission of neutrons in the entire temperature range of $\Delta T = 212-222$ K, corresponding to a ferroelectric transition. During the passage of a neutron flux from a ^{252}Cf neutron source through a cryostat with a crystal of KD_2PO_4 during a ferroelectric phase transition, a definite intensification of the neutron flux (depending however on the efficiency in the crystal-detector system) is observed, reaching a value of ~10% at $N_f/N_{fk} = 100$ (where N_f = the detector background) of the intensity of the source itself ($\Delta I_{max} = 29.514.7$ n/s) [sic]. The existence of cold nuclear fusion in deuterated solids is suggested.

E. MEETINGS AND CONFERENCES

RUSSIAN CONFERENCE ON COLD FUSION

Dear Mr. Fox,

At present we are concerned with organizing of the Third Russian Conference on Cold Fusion and Nuclear Transmutation, which will take place in a rest-home* in Sochi (on the shore of the Black Sea) during October 1-8 period.

The program of the Conference includes the following subjects:

1. Experimental research of Cold Fusion and Nuclear Transmutation with the different scientific methods and instruments;
2. Cold Fusion and Nuclear Transmutation theoretical models;
3. Cold Fusion applied technologies and devices.

We are pleased to invite you to participate at this conference and to make a report on any subject preferred by you. No preliminary abstract of the report is needed but please send us the title of your report, if it will be presented. The language of the Conference will be Russian and translation into English will be available.

If you want to take part in our Conference you should inform us by Fax until July 15, for we will be able to organize your meeting and provide you with railway tickets.

The registration fee of \$500 for participants, which covers Conference proceedings, a hotel stay in Moscow and transportation by railway from Moscow to Sochi and back. If you pay before July 15, your fee may be reduced to \$450. In this case, we inform you about our account number. Accommodations in Sochi must be paid by every participant personally. The price of the room can vary from \$25 to \$50 per person per night. The price of the meals (breakfast, dinner and supper) is equal to \$10 per day.

We will be ready to meet with you from September 28 to noon of September 29 in Moscow, if you would give us the information about flight date and number. The projected date of return flight from Moscow is October 10-11. Please inform us of your E-mail address.

Sincerely
/s/ Yury N. Bazhutov
Vice-Chairman of the Organizing Committee

/s/ Valery P. Koretsky
Coordinator of the Organizing Committee

*The Russians idiom uses "rest-home" for a **vacation resort**.
They go there to rest, we go there to vacate. -Ed.

F. EDITORIAL

2002 - THE BIG NEWS

New News -- Salt Lake City, Utah, June 16, 1995. A news flash from Budapest: Salt Lake City, Utah is chosen to host the Winter Olympics, 2002. A "party of the century" begins. Centered in the square surrounding the old City and County Building, thousands of Utahns cheer mightily at the news.

Old News -- Salt Lake City, Utah, March 23, 1989. At a news conference called by the University of Utah, Professors Stanley Pons and Martin Fleischmann (both renowned electrochemists) announce the discovery of low-energy nuclear fusion in an electrochemical cell.

With \$59 million (estimated) spent on the Winter Games to prepare sites and win the bid, and an estimated \$795 million more to be spent on site preparation, ceremonies, events, etc. Utah is preparing for the February 9 to February 26, 2002 winter games. Two billion people are expected to see some of the coverage of this 15-day sports competition.

With \$5 million spent by Utah on cold nuclear fusion in 1989-1990, and an estimated \$10 million spent by the United States, Pons and Fleischmann moved to France where their work has been supported by Japanese funds. With an estimated \$100 million spent (world-wide) on cold nuclear fusion, this new science is now being commercialized.

The world will little note nor long remember what happens at the February, 2002 Olympics, except for the medal winners. The impact of the announcement of the discovery of cold fusion will reverberate through history. Billions of people now living and yet to be born will be benefitting from this important new science.

"New Power For You in Two Thousand and Two."

Let us set a motto and a goal to match the sports efforts for 2002. When the crowds convene in Salt Lake City, Utah in February, 2002, let's have the following items all ready in place and working (but not only in Salt Lake City):

1. On-board battery chargers for the electric cars and buses.
2. New energy hand warmers for coat pockets of visitors.
3. New energy heaters for the tents, houses, homes, buildings, and gyms.
4. Fresh food grown locally in greenhouses powered by new energy heaters.
5. Billboards with new-energy power to say in lights: "Welcome to Utah, the New Energy State."

6. Non-polluting electric vehicles prevalent on the freeways and highways.

7. New-energy powered TV broadcast transmitters in vans and on hill tops to broadcast to the world: "This broadcast of the Winter Olympics is coming to you from Utah, the New Energy State."

8. New-energy inventions being used in various parts of the world to stabilize radioactive debris.

9. New-energy cookers used world wide to slow down cutting of forests.

The staff at **Fusion Information Center, Inc.** is dedicated to help make this scenario come to fruition. We need the help of inventors, engineers, scientists, business managers, and investors. Here is our proposal and objectives for NEF:

1. We will establish a New Energy Foundation (NEF) to promote the development of new energy systems.

2. All research and development groups, all manufacturing and distributing companies, all intellectual property groups, and all investing entities who are to be involved in the development of New Energy Systems are asked to join the NEF.

3. Representatives from all groups will be hosted by the NEF to set world-wide specifications and standards for new energy systems.

4. The NEF will establish an approved safety and quality standard to go along with "Manufactured to NEF Standards." to be placed on all new energy products.

5. Provide for the free exchange of information (immediately after inventions are protected by proper patent applications) among NEF members.

6. Provide for adjudication of intellectual property disputes without recourse to expensive litigation.

7. Provide a source for multi-lingual computer-based educational materials about new energy concepts and systems.

8. Provide a system for the handling of international trade in new energy educational materials, components, devices, and systems.

9. Provide a computer-accessible database for all members of the NEF and their customers and clients.

10. Provide for a clearing house for employment and consulting opportunities for scientists, engineers, technicians, and business consultants for members of NEF and their customers and clients.

11. Provide for the publication on various media of information about new energy concepts, products, services, and investment opportunities.

12. Provide a source for accurate information to the media concerning new energy, its members, and its collective products and achievements, world-wide.

13. Provide an interface among inventors, engineers, entrepreneurs, and investing entities.

14. Provide for an unbiased, peer-review or evaluation of project proposals for the purpose of improving such submissions before presentation to funders.

15. Provide and operate an NEF member's computer bulletin board for latest new energy information.

NEW ENERGY FOUNDATION FOUNDERS APPLICATION

The undersigned desires to become a founding member of the **NEW ENERGY FOUNDATION (NEF)**, a not-for-profit corporation to be filed under the standard commercial laws of the State of Utah.

I agree to help develop and abide by the rules and regulations governing this body and to help promote the development, distribution, use, and knowledge of new energy concepts, devices, and systems:

Name: _____

Mailing Address: _____

Telephone: _____ FAX _____

e-mail: _____

Enclosed is \$10 for individual founders first year membership. Enclosed is \$100 for corporate founders first year membership. Papers will be filed as soon as 50 founder applications are received. Thereafter members dues will be \$25 for individuals and \$250 for corporations (or as otherwise determined by the NEF Advisory Board.)

Mail to P.O.Box 58639, Salt Lake City, UT 84158

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