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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This issue of *Fusion Facts* is dedicated to the scientists, theorists, researchers, writers, and publishers who have made tomorrow possible.

This issue and the next will contain the abstracts of the papers that have been presented at the

Fifth International Conference on Cold Fusion

held in

Monte Carlo, Monaco

on April 9-13, 1995

A. BEHIND THE SCENES AT ICCF-5

By Hal Fox

One of the most impressive presentations at the ICCF-5 was given by Dr. Dennis Cravens and supported by a working cold fusion cell set up in the foyer by Clean Energy Technologies, Inc. (CETI) of Dallas Texas. Attendees at the conference could take their own data, compute the results, and show that a cold fusion cell was operating at 200 to 400 percent excess thermal power. This cold fusion system utilized the patented inventions of James A. Patterson. This invention consists of small plastic beads coated with copper, nickel, and palladium. These beads provide a uniform large surface area (of either palladium or nickel) to catalyze the nuclear processes that are the heart of cold fusion phenomena. The CETI patents cover both light and heavy water electrolysis using the metal-coated microspheres.

Not only was the working reactor a successful scientific presentation but it was also one of the forerunners of the commercialization of cold fusion. A former investment banker (who just happens to be a grandson of Patterson) is the president of CETI which is dedicated to the commercialization of the Patterson patents.

We have long touted the concept that the cold fusion developers need to demonstrate cold fusion reactors that are reproducible and that provide thermal power that is at least 300 percent larger than the input electrical power. That stage has now been achieved. Due to the higher costs of electrical power, thermal power produced by a cold fusion reactors must be competitive with the use of natural gas for the production of thermal power. In general, electrical power costs about three times as much as natural gas. Now we have cold fusion thermal power available at about the cost of natural gas thermal power **but without the pollution of the atmosphere.**

However, there is another more compelling reason for seeking the triple output. Thermal to electric converters are not highly efficient. Using the best available thermal to electric converters, we need to have at least 300% excess

thermal power to convert thermal power into electrical power. With the new developments in both cold fusion reactors and in new thermal electric converters, it now appears that we can provide the thermal energy sufficient to convert to electrical energy to have a self-contained energy-producing system. Assume a 40% efficient thermal to electrical converter (laboratory models are now up to about 60%). Assume that we input 100 watts into a cold fusion reactor and produce 300 watts of thermal power. By using that excess heat and a thermal-electric converter, we can provide 120 watts of electrical power to recharge the batteries used for the input to the cold fusion power system. **In addition, we also have 180 watts of thermal energy to be used for some industrial application.**

The engineering design considerations now should concentrate on improving cold fusion reactor system effectiveness by any of the following:
1. Increasing the efficiency of the reactor.
2. Increasing the temperature of the thermal output by pressurization.
3. Increasing the efficiencies of the thermal-electrical converters.
4. Increasing the efficiency of the system's heat exchangers.
5. Designing for explicit applications to industry, e.g., heat for distillation, heat for food preparation, power systems for heating and air conditioning, electrical power plus thermal power systems, etc.

Some of the real stories of the ICCF-5 are yet to be told. We know of over 300 patents that have been issued internationally and properly filed with **(and questioned by)** the U.S. Patent Office. We only have access to this public information 18 months after a patent is filed internationally or has issued internationally. Therefore, our latest information on patents is at least 18 months old. We are aware of considerable developments that have been made in the areas of cold fusion that are not, as yet, being made public.

The individual inventor/scientist has the choice of making his/her progress known to the world. The inventor or scientist who is funded by any type of commercial enterprize must adopt the disclosure regulations that are imposed by the company that pays for the research and development. For example, we know that Pons and Fleischmann began with reactors that only provided milliwatts of power. But that was six years ago. We know that they have been well-funded and that they are clever scientists. We do know, from their presentations, that they have moved to a few watts, then tens of watts in their development. However, there has been no significant publications from Pons and Fleischmann detailing their latest achievements. We would be surprised if they were not working on closed cells that are designed to produce hundreds of watts of power.

There are dramatic developments going on. An AMOCO scientists gave a presentation of his 1989 and 1990 efforts to replicate the Pons-Fleischmann work. He reported 30% excess thermal power from the 1989 work. Now there are three scenarios: First scenario, AMOCO has decided that there is little future in a device that produces only 30% excess thermal power and has abandoned cold fusion research and, therefore, has permitted the publication of their work. Second scenario, AMOCO is continuing to fund cold fusion R&D and to obtain a patent position in this viable new technology. Third scenario, AMOCO is willing to follow the developments of others and buy into cold fusion at a future time when it becomes a commercially viable technology. **We wonder how many other companies are working in cold fusion technology but are not publishing their results.**

Some of us who enjoy the confidence of some of the cold fusion scientists are often told of "previews of coming attractions." To protect our sources, we are not able to publish information until permitted to do so. Sometimes it is frustrating to know of excellent work but not be able to share the information. However, we can suggest to our readers that there are some interesting developments going on. **Do not read too much into this statement. We do not have knowledge of any specific production prototype that is ready to emerge as a commercial product except for those reported to our readers, the latest being the CETI product.** Appropriate announcements of other developments will be made as soon as the scientists involved give their permission.

Enhanced Energy Devices

At the insistence of the University of Utah, Pons and Fleischmann were asked to give a preliminary press conference on March 23, 1989. This new energy development, even though it provoked considerable negative responses, became a rallying point for a variety of other unusual energy devices (which we have labeled Enhanced Energy Devices.)
Thanks to the willingness of the cold fusion community to share information, there is a lot more organized exchange of information about other types of new energy systems: rotating machines, magnetic motors and generators, solid-state circuits, and cavitation systems, all of which are now openly discussed, designed, and (in a few cases) manufactured.

There have been some dramatic developments in this arena, for example, the Aspden Effect (Virtual Inertia), the Magnetic Resonance Amplifier, and at least one successful over-unity rotating magnetic machine. There are now several organizations who have received funding for the further development of devices and/or systems to commercialize enhanced energy devices that appear to tap the energy of space (vacuum-energy.) We will continue to report these

developments to you both in *Fusion Facts & New Energy News.*

Publication Sources

Attendees at the conference include editors and/or publishers from *Fusion Facts, New Energy News, Cold Fusion Times, Fusion Technology, Physics Review A, 21st Century Science and Technology, "Cold Fusion",* and a new publication *Infinite Energy.* The editors are Hal Fox (first two), Mitchell Swartz, George Miley, J-P Vigier, Carol White, Wayne Green, and for the new publication, Eugene Mallove. Other publications that have published peer-reviewed articles are Nuovo Cimento, and, of course, Journal of Electroanalytical Chemistry. Anyone who is seriously interested in the development and commercialization of cold fusion and other enhanced energy projects should ensure that they have access to these publications.

B. NEWS FROM THE U.S.

CALIFORNIA - EXCESS POWER MEASUREMENT

M.C.H. McKubre, S. Crouch-Baker, S.I. Smedley, and F.L. Tanzella (SRI International, Menlo Park), "The Measurement of Excess Power in the D/Pd System Under Nearly Isothermal Conditions," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #201.

AUTHORS' ABSTRACT

Observations of anomalous excess power generation in the D/Pd system have been made with sufficient regularity, precision and reproducibility to conclude that a real, and potentially interesting phenomenon is being observed. Whatever the phenomenon is, however, its cause is not known, and no established theory exists to guide us. In elucidating a mechanism, we are forced to proceed in an empirical manner.

An analysis has been undertaken to correlate excess power production in mass flow calorimeters, operating under nearly isothermal conditions, with the physico- and electro-chemical variables of the systems under test. Results will be presented in terms of a "fitting function" which displays a close empirical correlation with three cathode variables which will be defined and discussed in detail: excess loading, excess current density and the interfacial flux of D.

CALIFORNIA - CAVITATION INDUCED MICRO-FUSION

Russ George and Roger Stringham (E-Quest Sciences, Palo Alto), "Cavitation Induced Micro-Fusion as Evidenced by the Production of Heat, ^{3}He and ^{4}He," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #324.

AUTHORS' ABSTRACT

In experiments conducted by the authors at Los Alamos National Laboratory during a month-long series of experiments in 1994, evidence for controlled production of heat, ^{3}He and ^{4}He was obtained. Measurement of helium isotopes (both ^{3}He and ^{4}He) was performed by Dr. Brian Oliver of Rocketdyne/ Rockwell Laboratories in Canoga Park, CA. The experiments utilized the Mark II ultrasound micro-fusion reactor designed and operated by E-Quest. Experiments lasting from 3-20 hours were performed and samples of reactor gases taken in stainless steel sample flasks which were sent to Rocketdyne Labs for analysis with funding from the Electric Power Research Institute. Levels of helium in the reactor gases were observed as being 0.4 ppm (background) and as high as 552 ppm from successful experiments. The ^{3}He and ^{4}He were measured and found in separate experiments to be in ratios ranging from 1:10,000,000 to 1:182 where the naturally occurring ratio is observed to be 1:800,000. Further examination of target metals using SIMS analysis at Lawrence Berkeley Labs has provided some interesting mysteries in the isotopic ratios of certain elements.

CALIFORNIA - DEUTERATED METALS AT EPRI

Thomas O. Passell (Nuclear Power Group, Electric Power Research Inst., Palo Alto), "Overview of the EPRI Program on Deuterated Metals," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts., # 616.

AUTHORS' ABSTRACT

Some six years have elapsed since the first announcement by Fleischmann, Pons and Hawkins (1989) of the observation of excess heat from palladium heavily loaded with deuterium. The EPRI program began in April, 1989, and has continued to the present time attempting to replicate the claimed excess heat and determine its source. Under conditions difficult to achieve, some 16 separate experiments have successfully reached that goal out of some 35 major attempts. The conditions found necessary for an observation of excess heat were found to be at least three in number: 1) atomic loading ratio (D/Pd) > ~0.9; 2) initiation time of 8 to 23 days; 3) current density >0.1 amperes per cm^2 of cathode area. A fourth condition recently suggested by the results of an experiment is that the FLUX of deuterium across the palladium metal surface must be above some threshold value. No definitive source for the excess heat has been yet robustly determined, but measurable helium-4 has been observed in the cell vapor space in a few cases. The major evidence that the heat may be from nuclear reactions is

its magnitude - some 10 to 100 times larger than any known chemical reaction. The objective of the continuing effort is focussed upon identifying the source of the excess heat.

CALIFORNIA - THERMODYNAMIC PROPERTIES

S. Crouch-Baker, M.C.H. McKubre and F.L. Tanzella (SRI International, Menlo Park), "Some Thermodynamic Properties of the H(D)-Pd System," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, # 506.

AUTHORS' ABSTRACT

In any discussion of the origin, measurement or description of the anomalous power producing process which occurs in connection with the electrochemical loading of deuterium into palladium, knowledge of the thermodynamic behavior of the system is clearly of importance. More particularly, since the formation of highly loaded palladium is implicated as a necessary (but itself insufficient) condition for the observation of anomalous power(1), the thermodynamic properties of the system for H(D) / Pd > 0.8 require careful examination. In most cases, the variations with temperature, pressure and composition of the state functions of interest have not been determined experimentally. In favorable cases, however, these may be inferred or calculated.

Here, it is intended to review, at a general level, those aspects of the thermodynamic nature of the H(D)-Pd system, both equilibrium and non-equilibrium, which appear to bear most directly on the question of excess power production in relation to the attainment of high loadings. For example:

(1) The non-ideal behavior of hydrogen in palladium.

(2) The essential differences between loading under equilibrium conditions (e.g. gas loading) and non-equilibrium conditions (e.g. electrochemical or gas phase atomic loading).

(3) The expected variation of electrochemical loading with overvoltage, current, applied pressure and temperature according to possible electrochemical reaction mechanisms.

(1) M.C.H. McKubre, S. Crouch-Baker, R.C. Rocha-Filho, S.I. Smedley, F.L. Tanzella, T.O. Passell and J. Santucci, *J. Electroanalytical Chem.*, 368, 55 (1994).

CALIFORNIA - CALORIMETRIC PROBLEMS

M.H. Miles (Chem. & Mat. Br., Res. & Tech. Div., Naval Air Warfare Center Weapons Div., China Lake), "Calorimetric Problems in Measurements of Excess Power During Pd-D_2O Electrolysis," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #214.

AUTHOR'S ABSTRACT

There is no steady state for either the cell voltage or the cell temperature during D_2O + LiOD electrolysis experiments in open, isoperibolic calorimetric systems. Exact calorimetric measurements, therefore, require the application of the nonlinear, inhomogeneous differential equation that governs the behavior of the calorimeter. This was not done by most laboratories reporting electrochemical calorimetric results in 1989-1990 including studies by CalTech, Harwell and M.I.T. Furthermore, accurate electrochemical calorimetric measurements require proper calorimetric cell designs including scaling, and the careful control of external experimental conditions such as the ambient laboratory temperature and all liquid levels. The 1989 publications by CalTech will be used to illustrate important calorimetric principles, problems and sources of error in attempts to measure excess power in the Pd-D_2O electrolysis system.

INDIANA - THEORETICAL UNCERTAINTIES

Yeong E. Kim and Alexander L. Zubarev (Dept. Phys., Purdue Univ., West La Fayette), "Uncertainties of the Conventional Theoretical Estimates of Low-Energy Fusion Rates due to Electron Degrees of Freedom," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #407.

AUTHORS' ABSTRACT

We investigate non-adiabatic effects in the quantum mechanical description of the electron screening effect for nuclear reaction rates. At low energies, the fusion reaction cross-sections of charged nuclei can be also written as

$$\sigma(E) = G(E) \left| \psi_E(0) \right|^2 / v \qquad (1)$$

where $G(E)$ is the so-called astrophysical factor, which embodies the nuclear aspects of the process, E and v are the collision (kinetic) energy and the relative nuclear velocity, respectively, $\psi_E(0)$ is the wave at the origin, and $\left| \psi_E(0) \right|^2 = (2\pi\alpha c/v) \exp(-2\pi\alpha c/v)$. At low energies, the behavior of $\sigma(E)$ is dominated by Coulomb repulsion between the nuclei. In cold fusion and laboratory beam experiments the ion is incident on a target consisting mostly of neutral atoms or molecules, and hence incident ions can recombine, partially or totally, with the electrons they encounter while moving through the target. As a consequence, the final nuclear collision, which leads to nuclear fusion, occurs while the nuclei are surrounded by one or several electrons. These electrons become more deeply bound in the Coulomb field of the unified nuclei, and

transfer kinetic energy to the internuclear degree of freedom. Therefore, the cross-section measured in the laboratory beam experiments is not equal to the cross-section for bare nuclei. Recent results for $\sigma(E)$ from laboratory beam experiments for nuclear reactions involving light nuclei at low energies (> 3 keV) show that the extracted *S(E)* increases toward lower energies instead of being a constant extrapolated from higher energy data, indicating the importance of the electron screening. However, recent theoretical calculations of the electron screening effect based on the adiabatic Born- Oppenheimer approximation (the united atom model with the screening energy,15.7 $Z^{7/3}$ eV) yield limiting values which are much smaller (by ~ 1/2) than those extracted from the experimental data for reactions ^{3}He(d,p)^{4}He, ^{6}Li(p,α)^{3}He, ^{6}Li(d,α)^{4}He, and ^{7}Li(p,α)^{4}He. This discrepancy between the experimental data and the conventional theoretical estimate for the electron screening effect is not understood at present.

We will now examine the united atom approximation for low-energy d + de reaction. For this case need to calculate

$$|\psi_E(0)|^2 = \int |\psi_E(\vec{r},\vec{\rho})|^2 d\vec{\rho}\,|_{r=0} \qquad (2)$$

For the total d + de energy $\epsilon = E - |E_{1s}| = (E - 13.6\ \text{eV})$ where $\vec{r} = \vec{r}_{d_1} - \vec{r}_{d_2}, \vec{\rho} = \vec{r}_e - (\vec{r}_{d_1} + \vec{r}_{d_2})/2$ we assume that $\psi(\vec{r},\vec{\rho})$ in eq. (2) is the solution of the Schrodinger equation

$$\left(-\frac{\hbar^2}{2\mu}\Delta_r - \frac{\hbar^2}{2m_e}\Delta_\rho + \frac{e^2}{r} - \frac{e^2}{|\vec{\rho} - \frac{\vec{r}}{2}|} - \frac{e^2}{|\vec{\rho} + \frac{\vec{r}}{2}|} \right) \psi = \epsilon\psi \qquad (3)$$

and μ is the reduced mass of deuteron, $\mu = M_d/2$, with the deuteron rest mass M_d. We expand the solution of eq. (3) in terms of $\psi_n(\vec{\rho})$ as $\psi(\vec{r},\vec{\rho}) = \sum F_n(\vec{r})\psi_n(\vec{\rho})$, where the eigenfunction $\psi_n(\vec{\rho})$ satisfy

$-(\hbar^2\Delta_\rho/2m_e + 2e^2/\rho)\,\psi_n(\vec{\rho}) = E_n\psi_n(\vec{\rho})$ and $F_n(\vec{r})$ satisfy

$$-\frac{\hbar^2}{2\mu}\Delta_r F_n(\vec{r}) + \frac{e^2}{r}F_n(\vec{r}) + \sum V_{nm}F_m = (\epsilon - E_n)F_n(\vec{r}). \qquad (4)$$

If we restrict to the case of n = 1 and $m = \epsilon$ (continuum state) and to the case of L = 0 and $\ell_r = \ell_\rho = 0$, the probability integral in eq. (2) can be written in terms of solutions, F_1 (adiabatic contribution) and F_ϵ (non adiabatic contribution), of eq. (4). For the low energy case of E $\leq$ 10 eV, our estimates yield the ratio

$$\frac{|\psi_E(0)|^2}{|\psi_E^{U.A.}(0)|^2} > \sim 10 \qquad (5)$$

where $|\psi_E^{U.A.}(0)|^2$ is the conventional adiabatic contribution (the united atom model). Our result, eq. (5), indicates the importance of the non-adiabatic contribution for the electron screening effect. Implications of this result for cold fusion will be discussed.

MARYLAND - DEVELOPMENT APPROACH

Bruce Klein (Bechtel Power Corp. Gaithersburg), "A Development Approach for Cold Fusion," presented at ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco.

AUTHOR'S ABSTRACT

A plan is presented for investigation and development of the cold fusion effect, ultimately leading to implementation of commercial devices. The plan represents a methodical approach for identifying and addressing theoretical, scientific, engineering and economic concerns.

The plan is presented from the perspective of a large architect/engineering corporation which performs work in established energy industries and which is not currently involved in cold fusion. The plan consists of a number of phases designed to establish the corporations level and method of involvement in the field.

The phased plan provides a number of decision points; at each decision point a commitment to a higher level of funding is made on the basis of additional information which has been generated by the plan to that point. In this way the corporation can control its financial outlay, yet funding is appropriate so that pursuit of the plan is not hampered.

MARYLAND - COLD FUSION ECONOMICS

Bruce Klein (Bechtel Power Corporation, Gaithersburg), "Cold Fusion Economics," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #613.

AUTHOR'S ABSTRACT

There are a number of proven alternative energy sources other than cold fusion which have not achieved widespread use. This is because their economic performance is insufficient to equal or better conventional power sources. An example is the solar photovoltaic cell, which in most locations cannot overcome the economic advantage of electricity generated by burning fossil fuels. To achieve implementation other than as laboratory curiosities, cold fusion devices will have to overcome the same economic hurdles.

This paper examines energy economics as they relate to the implementation of commercial cold fusion devices. The life-cycle costs of present-day energy sources, including first cost, operating and maintenance costs, and fuel cost are examined. Propulsion devices (automobile engines), heating devices (home furnaces) and electric generators (power plants) are examined.

The life cycle costs of these devices are compared with similar devices constructed using cold fusion apparatus. The lower continuing costs of operation of the cold fusion devices, due to reduced fuel and material costs, are projected. These are then used to identify limitations on the first cost of cold fusion machines. Possible configurations of cold fusion devices, and performance requirements to meet the cost limitations, are discussed.

MASSACHUSETTS - NEUTRON TRANSFER

Peter L. Hagelstein (MIT, Research Lab. of Electronics, Cambridge), "The Three Miracles: An Update on Neutron Transfer Reactions," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #411.

AUTHOR'S ABSTRACT

Energy transfer between a lattice and its constituents occurs either through (1) phonon creation or destruction, or through (2) frequency shifting of phonon modes. The latter effect is well known in molecular physics (as the Duschinsky effect), and leads to a transfer of electronic energy to vibrational energy. In condensed matter physics, the effect is also well known in the perturbative limit of small energy transfer (appearing as the second order Doppler shift in Mossbauer studies, and as the origin of Huang-Rhys factors). This effect is predicted to be capable of large energy transfer; we have proposed that it is ultimately responsible for all anomalies encountered to date in Cold Fusion experiments.

The amount of energy transfer ΔE is determined by the product of the number of phonons *N* and the phonon mode energy shift $\eta\delta\omega$

$$\Delta E = N\eta\delta\omega$$

For the energy transfer to be large, the number of phonons in the frequency-shifting mode must be large. Such a large phonon modal density can be produced by a phonon laser. We have proposed that at high D to Pd loading, the exothermic desorption of D_2 can drive optical phonon gain. We conclude that low-level conventional dd-fusion (from recoiling keV deuterons), and numerous other anomalous effects, are a consequence of optical phonon lasing on phonon modes bordering a gap between the optical phonon band and a vacancy band.

Accurate nuclear structure calculations often treat nucleon correlation through configuration mixing; the strong force provides a natural coupling between bound and continuum neutron orbitals. In a lattice, many nuclei are coupled to a common continuum, which leads to the possibility of neutron hopping (analogous to some degree to electron hopping in semiconductors). This is described by a neutron analog of the Anderson model, for which we have recently developed essentially exact solutions for nuclei with outer s-shell neutrons. In a cold thermal lattice, no neutron hopping occurs. In a hot or phonon-driven lattice, neutron hopping is predicted to "turn on" (when the coupling strength exceeds the zero-field NMR linewidth), and low-level gamma emission is predicted when the neutron hops to an inequivalent nucleus. If the lattice can accept the energy difference, then neutron hopping to the ground state of other s-wave nuclei is predicted to occur at a high rate. This mechanism provides a candidate explanation for heat and tritium production in Cold Fusion experiments.

MINNESOTA - SAMARIUM COBALT MAGNET USED

Dana Rotegard, Mark Hugo (Irish Holdings, Ltd., S. St. Paul), "Excess Heat from Deuterated Rare Earth Magnet $SmCo_5$ Used in Low Budget Home Experiment," presented in poster session at ICCF-5, Monaco, 9-13 April 1995.

AUTHORS' ABSTRACT

Cravens and Chukanov have suggested that magnetic fields and materials may influence the process that yields excess heat from materials saturated with deuterium or hydrogen. Deuterated Samarium cobalt, a powerful natural magnet, was heated in a 1 qt. Aladdin stainless steel vacuum thermos using an AC powered heater at various input powers. Temperature in the unpressurized container measured by an Iron/Const. thermocouple with a temperature rating of .055mV per degree C. An experimental sample was exposed to heavy water and a similar unexposed sample was the control. Over a two week period the deuterated sample showed indications of significant excess heat over the control when both were heated.

NEW MEXICO - TRITIUM PRODUCTION

T.N. Claytor, K.G. Tuggle and D.D. Jackson (Los Alamos Nat. Lab.), "Tritium Production from a Low Voltage Deuterium Discharge on Palladium and Other Metals," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #306.

AUTHORS' ABSTRACT

Over the past year we have been able to demonstrate that a plasma loading method produces an exciting and unexpected amount of tritium. In contrast to electrochemical hydrogen or deuterium loading of palladium, this method yields a reproducible tritium generation rate when various electrical and physical conditions (gas pressure, gas purity, initial palladium metallurgy, etc.) are met. Small diameter wires (100-250 Microns) have been used with typical gas pressures above 200 torr at voltages and currents of about 2,000V at 3-5 A. By carefully controlling the sputtering rate of the wire, runs have been extended to hundreds of hours allowing a significant amount (> 10's nCi) of tritium to accumulate. No pre- or post-gamma activity or neutron emission (to 1 C/hr) has been detected in any of the samples. We will show tritium generation rates for deuterium-palladium foreground runs that are up to 25 times larger than hydrogen-palladium control experiments using materials from the same batch. The reproducibility of the technique and the large signal to noise over background has allowed us to vary parameters that have been difficult to investigate with previous methods. We intend to illustrate the difference between batches of annealed palladium and as received palladium from several batches to demonstrate that the tritium generation rate can vary by a factor of 40 from batch to batch. The effect of other metals (Pt, Ni, Nb), gas pressure, wire and plate thickness on the tritium generation rate will be shown. We plan to discuss these new procedures (including the effect of gas impurities, and palladium purity), present typical results, and speculate concerning the implications for further work.

NEW MEXICO - CRITICAL REVIEW

Edmund Storms (Los Alamos Nat. Lab. (retired)), "A Critical Review of the Cold Fusion Effect," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #101.

AUTHOR'S ABSTRACT

Studies reporting evidence for the "cold fusion" effect are evaluated. New work has answered criticisms by eliminating many of the suggested errors. Evidence for large and reproducible energy generation as well as nuclear reactions, in addition to fusion, from a variety of environments and methods are accumulating. The field can no longer be dismissed by invoking obvious error or prosaic explanations. Unfortunately, skeptical attitudes continue to inhibit normal acquisition and publication of information.

TEXAS - LANT MODEL

J.O'M. Bockris, R.T. Bush, G.H. Lin, and R.A. Monti, "Lattice Assisted Nuclear Transformation (LANT)," pre-publication copy.

AUTHORS' ABSTRACT

This paper discusses a kind of Nuclear Revolution, cold nuclear reactions produced between charged particles of low energy, brought together in a condensed matter environment. The first indications of this low energy path (cold fission, cold fusion) occurred in a number of experimental investigations from 1943 to 1980, claiming to show that, under solid state confinement, nuclear changes could be brought about, by means of stimuli minuscule compared with those of high energy physics. Doren and Kushi are reported by Monti as stating that the elements Si, Al, Ca, Mg, Mo, Ni, Na, K, Pt, Au, and Hg can be produced from elements of atomic numbers 1-8. It is little known that American government laboratories ran a series of projects in the 60's and 70's in which neutrons were produced by "capillary fusion" resulting from kiloamp pulses made to flow through wires.

In 1989, Fleischmann and Pons presented evidence for nuclear reactions involving D atoms confined in a Pd lattice. They reported neutron emission, indirectly obtained evidence of tritium formation, and reported heat emission at ~tens of watts cc^{-1} (later, these values were greatly increased). No mention of antecedent work indicating nuclear transmutation reactions in the cold was made.

There has been, as yet, no consensus among several theoretical interpretations. "Cold Fusion" is an inappropriate title to cover the spreading field. A title more reflecting the breadth of the phenomena is "Lattice Assisted Nuclear Transformation," or LANT. The aim of this paper is to describe the several types of these changes in one paper for the first time.

Six kinds of low nuclear reaction are described. The first has been carried out worldwide: it occurs in heavy water electrolytic cells in palladium when D/Pd is greater than 0.8 with a minimum of cracking. Rf triggering and electrochemical triggering can be used to introduce the reactions. Nuclear products - tritium, helium and x-ray emission were experimentally observed. Excess heat, up to 4 kW/cc has been reported.

The second kind of nuclear reaction happens in the light water electrolysis system. Excess heat and x-ray emissions were observed. A transmutational product, Sr, was detected by means of SIMS and ICPMS. Thus, the heat produced in the light-water system might be due to a low rate of nuclear

transformation in which, e.g., Rb, is converted firstly to Sr by the addition of a proton.

The third consists of transmutation reactions in solid lattices. Borghi claimed to have formed neutrons in a "cold plasma." Kervran reported a number of cold fission reactions, in particular from Pb to Nb to Rh. Kucherov reported more than 40 experiments in which new nuclei are formed in Pd saturated with D. Dash reported that Ag and Au appeared in his Pd electrodes upon electrolysis of light water on Pt. Ohmori and Enyo found Fe formed in Au electrodes after electrolysis in light water on a gold cathode. The Fe does have an isotopic abundance significantly different from that of natural Fe. Rolison and O'Grady observed a change in isotopic abundance of Pd in their electrodes after electrolysis. They found a near-surface enrichment of the 106 species and a near surface diminution of 105, 106, and 108. [Rolison's abstract cited dimunition of 105. --Ed.] Stringham and George have performed remarkable work in sono-illuminating Pd sheets in D_2O. They find excess heat but also new He^4 and Cd^{114} as a result of the sono-illumination.

The fourth nuclear reaction is the iron formation from carbon. Reports of scientific work on which passage of an electric current through carbon is claimed to have formed Fe were first authored by Oshawa, and later by Borghi. Recent experiments were performed by the scientists in the Bhabha Atomic Research Center and at TAMU. However, the evidence from isotopic abundance measurements is not confirmatory.

The fifth nuclear transmutation is precious metal formation by means of gun powder method. Modern experiments in which it is claimed that small amounts (about 0.1% by weight) of noble metals are synthesized from cheap heavy metals have been reported from two separate sources, Champion and Monti, in the USA during this decade. A number of check experiments were carried out at Texas A&M University. Around 20% of the experiments were "successful" as defined by producing 0.01 - 0.1% by weight of noble metals from a kg of starting material. Patel and LaStella have independently claimed successes in the noble metal production. Recently, Gromovoy et al. reported that noble metals (Au, Os, Pd) could be formed from lead and other materials, which contained no noble metals. The total content of the new metals ranged from 0.01 to 0.26%.

The sixth phenomenon is nuclear change in biological organisms. The idea that "creation" of elements occurred in biology goes back to 1822 when Prout found an increase in Ca in the chick embryo without a corresponding decrease in the CaO in the lime. Kervran claimed to have demonstrated a change of e.g., Na to Mg under biological conditions. Komaki had been the leader, since 1970, in reporting experiments which seem to evidence nuclear reactions in biology. Goldfein hypothesized that ATP could act as a molecular level cyclotron and convert elements into the next element in the periodic table, e.g., Cu could be converted biologically to Zn. Recent support for biological transmutation is from Alper, who showed that Pedomitrobium, a micro-organism, produces metallic gold.

These six phenomena imply that, in solid lattices, certain nuclei can undergo transmutational changes stimulated only by chemical level energies. The evidence is uneven. Thus, some phenomena (e.g., the heavy water and light water excess heat effects and the ^3He formation from ^2H containing systems) have been multiply reproduced the world-over. On the other hand, the evidence for some (e.g., the gun powder experiments of low reproducibility) is weak, although findings of radioactivity demand an explanation. Taken together, these six phenomena strongly suggest that chemical level energies can stimulate nuclear changes in some lattices. They suggest the reality of Lattice Assisted Nuclear Transmutation (LANT), and may be proposed as giving rise to a new field, the Nuclear Physics of Condensed Matter. Given this development it would hardly be surprising, then, if there were practical ramifications. Of these, the most significant potential developments could be a practical nuclear energy source with ^4He as the by-product and electrochemical production of tritium at a small fraction of present costs ($1,000,000 per gram).

TEXAS - FLOWING ELECTROLYTE CALORIMETRY

Dennis Cravens (Vernon Comm. Col., Texas, & Member of ENECO Sci. Advis. Bd.), "Flowing Electrolyte Calorimetry," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #208.

AUTHOR'S ABSTRACT

Circulation of the electrolyte through a cold fusion cell allows high current densities and high energy fluxes within a cell with few complications. When the specific heat and flow rate of the electrolyte are known, the thermal output of such cells can be calculated similar to flow calorimetry techniques. Benefits of such systems include:

1) operating at high power densities;

2) using high current densities at the cathode;

3) sampling of electrolyte after loading;

4) adjustments to electrolyte composition during a run;

5) increasing conductivities of electrolyte after loading;

6) operating the cell in a vacuum environment for increased calorimetric accuracy; and

7) calibrating advantages of flow calorimetry.

The cell is based on the "Patterson cell design" and uses palladium and/or nickel coated beads to produce a large area cathode.

TEXAS - EARLY DESIGN AND EXECUTION

Melvin Eisner (Univ. of Houston, Phy. Dept., Houston), Theodore V. Lautzenhiser, Daniel W. Phelps (Amoco Production Company), "The Serendipitous Design and Execution of an Early Experiment which Confirmed Heat in the Fleischmann-Pons Effect," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #212.

AUTHORS' ABSTRACT

Following the release of information of the Pons-Fleischmann effect a great number of people attempted to verify the existence of the effect. At the time we were engaged in a project aimed at developing a device for measuring gradients of gravitational field in boreholes and this required the development of a highly precise calorimeter. A brief description of that instrument and the requirements of that experiment will be discussed. Since this instrument was easily adapted for use in an experiment aimed at verifying the heat production reported by Pons and Fleischmann we were well positioned to set up an experiment aimed at verifying heat production and in fact the first experiment yielded at 30% energy gain over its two month life. Subsequent experiments were modified to use closed cells and the first version of these yielded a 30% gain before failure of the recombining catalyst ended the run. We present here the detailed results obtained in the next experiment which yielded 59 kj of energy over its 56 day lifetime.

UTAH - STATISTICAL METHODS

Wilford N. Hansen (Utah State Univ., Logan, Utah) and Michael E. Melich (Naval Postgraduate School, Monterey, California), "The Use of Statistical Methods to Extract Information from Open Dewar Calorimetric Data," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco.

AUTHORS' ABSTRACT

Special modeling and mathematical analyses have been designed for electrochemical calorimetry, and use has been made of statistical methods to maximize the information extracted. The application of our methods to open dewar calorimetry will be discussed, both routine and difficult cases. We have used these methods to analyze the open dewar cells of Fleischmann/Pons and others. Using basic physics it has been possible to construct and verify models of open and closed cell calorimeters with great refinement and thus improve the accuracy of the results obtained.

From detailed studies we conclude that data sets collected in reasonably documented experiments remain a valuable source of information on the F/P effect. Since the experiments take months, exploiting the older data sets is an efficient way of further understanding the F/P effect.

Also making use of the detailed methods, which is made easy by modern computers, gives simple dewar calorimetry a whole new appeal. Its response is fast, and calibration can be handled without ambiguities with short-time heater input. Temperatures to near boiling can be used conveniently. Important details of setup have been implemented which enhance its reliability and accuracy. Thus for cases where sets of experimental conditions are being explored, simple dewar calorimetry might still be the calorimetry of choice.

UTAH - STATISTICAL ANALYSIS

Wilford N. Hansen (Utah St. Univ., Logan), "A Statistical Approach to Electrochemical Calorimetric Analysis," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #213.

AUTHOR'S ABSTRACT

A unique mathematical analysis especially designed for electrochemical calorimetry will be presented and discussed. Its advantages will be demonstrated using real data from difficult cases as well as from routine cases. By using this approach, more simple, inexpensive and responsive calorimeters can be used. Also the analysis methods help deal with non-ideal calorimetric conditions caused by unforeseen circumstances. The methods also help deal with historically significant data that cannot in reality be retaken, and where it is important to extract the maximum amount of information possible using the existing data.

Some demonstrated advantages of our methods include:

a) Only linear regression is used, which is much simpler and faster than non-linear regression.

b) Both conductive and radiative heat transfer coefficients are used, and ways of directly measuring each have been demonstrated. For such cases, both coefficients have been found to be constant up to the highest temperatures used (94°C).

c) In view of the validity of the analysis, the calorimeters can be used up to near boiling temperatures.

d) The simple differential form of the heat balance can be used directly point by point.

e) Calibration data can be handled without ambiguities. In fact all that is required is to add extra heat input with a known signature and/or change the cell current now and then.

VIRGINIA - ION BAND STATE THEORY

Scott R. Chubb and Talbot A. Chubb (Research Sys., Inc., Arlington), "The Ion Band State Theory," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, # 409.

AUTHORS' ABSTRACT

Almost as interesting as the success of our Cold Fusion theory[1-5] is the "uproar" that the theory seems to provoke. This has included an unreferenced "rebuke" by *Nature* Magazine[6], an unsolicited EDITORIAL COMMENT that was appended to one of our papers[7], and misstatements of fact about our theory in recent Cold Fusion (CF) theory "critiques"[8]. An important reason why the theory has provoked these responses is that it "seems" to have evaded a number of the potential problems that have bothered many people concerning CF, while successfully predicting[1-3] important excess heat phenomena (loading requirements, by-products, etc.) that were subsequently observed[4-5]. As we have explained recently [3-9], the theory is based upon quantum mechanical effects associated with Hydrogen-in-Metals that eliminate the particular phenomena that the skeptics have claimed are not included in the theory. For example, although considerable particle-particle overlap can occur between bound charged particles at points where the potential energy becomes infinitely repulsive or attractive in atoms, molecules and solids, skeptics both of our theory, in particular, and of CF, in general, have assumed that entirely different rules for overlap apply[8]. Confusion has also resulted because of the widely held belief that in CF, nuclear reactions must occur at a point, as they do in conventional fusion. Because hydrogen (H) is capable of behaving in a wave-like fashion inside and on the surfaces of transition metals[3-9] under certain circumstances, it really becomes quite impossible for hydrogen to interact either with itself or its environment at one specific location. This idea, which comes from mainstream solid state physics, has been used to explain a number of anomalies[9] involving H interacting with transition metals. After five years, it has become apparent that these ideas, which follow from well-known results that are familiar to solid state physicists, are not widely known by the larger physics community. For this reason it has been both necessary and informative to explain how basic solid state ideas associated with the physics and chemistry of Hydrogen-in-Metals can be used to explain a number of important Cold Fusion phenomena. The presentation will focus on the questions that have been raised by the skeptics, the answers to those questions, and the larger, hidden lessons associated with the process of communicating ideas and effects, which though well-known in one field, are more commonly viewed[6] (at least according to *Nature* magazine) to be the "jargon, at once forbidding and enticing, of solid-state physics, ...[which] ....like the latest Paris Fashions, outface[s] mockery?"

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C. NEWS FROM ABROAD

BELARUS - NEUTRON EMISSION IN CRYSTALS

K.A. Kaliev, V.A. Filimonov, et al. (Kaliev Ent., Santa Rosa, California & Inst. Physicochem. Prob., Minsk), "Investigation of Neutron Emission in Series of Identical Experiments on Oxide Bronzes Na_xWO_3 Single Crystals Deuterated from the Gas Phase," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #314.

AUTHORS' ABSTRACT

In a series of identical experiments on oxide tungsten bronzes Na_xWO_3, deuteration by gas loading is carried out. Appearance of neutron emission from the cell correlated with deuterium gas input during the first five minutes after input is proved. The signal and background distributions are analyzed and shown to be non-equivalent. Diffusion processes are

shown to make a significant contribution to the observed phenomena.

CANADA - HEAVY WATER PRODUCTION

R. Machacek (Ontario Hydro International, Toronto, Ontario), "Heavy Water - Source of Deuterium in the Pd-D System." ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstract, #508.

AUTHOR'S ABSTRACT

In the study of the production of excess heat from highly deuterated palladium cathodes, increasing attention is being given to the system materials. Heavy water electrolyte serves as the source of deuterium in electrochemical cells. This paper reviews the history of heavy water production and heavy water production methods, with particular emphasis on the Girdler-sulphide process. Thermodynamic properties and details of chemical and physical analysis of a typical heavy water product are also presented.

CANADA - VARIATIONS OF HALF-LIVES IN CF

Dr. R.A. Monti (research assoc., Burns Devel. Ltd., Delta, B.C.), "Variations of the Half-lives of Radioactive and Associated Cold Fusion and Cold Fission Reactions," presented at the ICCF-5, Monaco, 9-13 April 1995.

INTRODUCTION

According to the Alpha-Extended model of the atom, heavier elements are made from lighter elements by Low Energy Transmutations (Cold Fusions). Conversely, lighter elements can be produced by Cold Fission of heavier elements.

Cold Fusion and Cold Fission are complementary and reversible processes. Some ordinary chemical reactions can cause Cold Fusion and Cold Fission of stable nuclei. This led me to test the effects of similar chemical reactions on unstable (radioactive) nuclei during early 1993 and a new series in March 1995 which is detailed herein.

OBJECTIVE

To achieve and observe Cold Fusion/Fission in radioactive elements by using a variety of proprietary formula Fusion/Fission Mixtures (FM's) and Collecting Elements (E's) and noting changes to radioactivity or evidence of significant changes to quantity of elements.

CHINA - THE HEAT WITHOUT RADIATION PUZZLE

XingZhong Li (Dept. Phys., Tsinghua Univ., Beijing. Current address: Dept. Chem., Univ. of Hawaii at Manoa, Honolulu, HI), "Solving the Puzzle of Excess Heat Without Strong Nuclear Radiation," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #402.

AUTHOR'S ABSTRACT

Alter five years of intensive investigation, the excess heat from deuterium in condensed matter under ambient conditions has been reproduced in various schemes (open system, closed system, and closed system with no recombination). At the same time, the nuclear measurements have shown that there are no commensurate neutrons, and no γ-radiation; the helium and the triton signals appear in an unconventional branching ratio. Does this anomalous phenomenon conflict with our 50-year knowledge of nuclear physics?

The Gamow penetration factor of the Coulomb barrier is the first problem, and the branching ratio after the penetration of the Coulomb barrier is the second problem. Could we solve these two problems in the frame of traditional nuclear theory?

The Gamow factor was first introduced for the case of the free-particle injection, or for the case of the free-particle emission. If the reactant particles are both confined in the solid, and if the energy level in the lattice potential coincides with the energy level in the nuclear interaction well, then the penetration factor should be Θ^{-1} instead of the traditional Gamow factor Θ^{-2} (Θ is a large number determined by the thickness and the height of the Coulomb barrier).

Usually, the idea of resonance penetration has been considered not applicable, because not enough attention has been paid to the difference between the confined particle and the free-moving particle. For the free-moving particle in resonance, the only requirement is that the energy of the incident particle has to match with the virtual energy level in the nuclear well. The absorption in the nuclear well might be arbitrarily strong. However, in the case of a confined particle in resonance, not only must the energy level in the lattice well coincide with the energy level in the nuclear well, but also the imaginary parts of the potential well are limited by the boundary conditions. In reality, the absorption in the nuclear well has to match with the penetrating flow from the source in the lattice well, in order to preserve the conservation of the current of the probability. If the absorption is too strong (stronger than Θ^{-1}), then there will be no resonance penetration. Just due to this reason, the fast nuclear reaction channels (e.g. $d + d \rightarrow {}^3He + n$) would not be in resonance. Since the resonance would enhance the penetration rate by a factor of Θ,

we see in the deuterated solid system the "slow" reaction channel; i.e. excess heat and helium without the commensurate nuclear radiation.

A 3-dimensional square well with the complex potentials is introduced to illustrate this new resonance penetration mechanism to solve the problem of the penetration of the Coulomb barrier in parallel with the solution of the unconventional branching ratio. The question of the narrowness of the resonance will also be discussed.

CHINA - MICRO-BAG MODEL

Kuangding Peng, Yuchang Yao, Ming Wang (Dept. Phys., Yunnan Univ., Kunming, PRC), and Zhengchang Wang (Dept. Phys., Yunnan Nat. Col., Kunming, PRC), "The Micro-Bag Model of Cold Fusion," pre-print of paper presented at ICCF-5, Monaco, 9-13 April 1995.

AUTHORS' ABSTRACT

The Micro-Bag model has been put forward, which can explain perfectly the cold fusion effect. The defects in Pd lattice can be occupied by D atoms, and micro-bag formed. In micro-bag, the temperature is very high, so a three-body collision of $_1D^2$, $_1D^2$ and e can take place. Through computing, we can prove that the total potential energy of the system constituted by the three particles can [be] less than zero when angles between the direction s of the momentums of the three particles are in a suitable scope. As a result of the collision, the nuclear reaction $_1D^2 + _1D^2 + e \rightarrow _1H^4 + \gamma_e$ can take place. Therefore, it leads to cold fusion.

CHINA - CONTRACTION OF POTENTIAL WELL

Kuangding Peng (Dept. Phys., Yunnan Univ., Kunming, PRC), "The Model of Contraction of Potential Well of Cold Fusion," pre-print of paper presented at ICCF-5, Monaco, 9-13 April 1995.

AUTHOR'S ABSTRACT

The effect of contraction of potential well and of Bose-Einstein Condensation has been discussed. Due to the two processes of concentrated energy, cold fusion is possible at special conditions.

FRANCE - EXCESS HEAT WITH $AlLaO_3$

Jean-Paul Biberian (Dept. Phys., Faculte des Sci. de Luminy, Marseille), "Excess Heat Measurement in $AlLaO_3$ Doped with Deuterium," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #205.

AUTHOR'S ABSTRACT

$AlLaO_3$ has a perovskite structure. When the crystal has the intrinsic composition, the sample is white. When lanthanum vacancies are created, the crystal turns red due to absorption of light by the colored centers. When the crystal is heated in an hydrogen or deuterium atmosphere, the hydrogen or deuterium atoms diffuse inside the lattice and fill the trivalent lanthanum vacancies. To balance charges, three hydrogen or deuterium ions fill every lanthanum vacancy. After loading, the crystal becomes white, due to the disappearance of the colored centers.

If a voltage is applied across a loaded sample, on the cathode side, the hydrogen or deuterium ions are attracted by the negative voltage, and there is an enrichment in hydrogen or deuterium up to five atoms per vacancy producing a blue color zone. On the contrary, at the anode, there is a depletion in hydrogen or deuterium, restoring the red color. The center of the crystal remains white. This is the so-called blue-white-red electrolysis.

We have measured excess heat when deuterated samples of $AlLaO_3$ are heated at temperatures in the 400-600°C range in a deuterium atmosphere, while a current is applied through the sample. We show that [instances of] excess heat of up to 10 times the input energy are detected.

In addition to excess heat, we have also measured neutrons and photons and we will discuss these results. We propose that excess heat is mainly due to the fusion of deuterium ions to form helium-4. We suggest that fusion occurs in the vacancies filled with deuterium. The density of the deuterium in these vacancies is close to or greater than that in liquid deuterium.

We believe that perovskites are excellent candidates for research on Cold Fusion, as well as for future device applications. However, perovskites have their own problems due to the difficulty in maintaining stability of the materials. Best designs for heat generators will be proposed.

FRANCE - EXPERIMENTERS' REGRESS

M. Fleischmann and S. Pons (IMRA S.A. Sci. Ctr., Sophia Antipolis), "The Experimenters' Regress," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, # 215.

AUTHORS' ABSTRACT

At the start of any controversial field of research it is not clear whether on the one hand:

all "negative" results are correct so that "positive" results are due to bad experimentation

or, on the other hand,

all "positive" results are correct so that all "negative" results are due to bad experimentation.

These statements are part of the "Experimenters' Regress," a concept drawn from the field of the Sociology of Science. Sociologists consider that the Regress cannot be broken. However, as Scientists we must recognise that the judgement of whether or not a given result is "negative" or "positive" is frequently dependent on the methods of data analysis used. These methods of data analysis are therefore part of the Regress (or form a Regress of their own). In practice, an "ultimate evaluation" (determined by the present state of knowledge of data processing) is rarely achieved because of limitations of time and money. Inevitably, therefore, the evaluation of any given data set cannot be regarded as having been completed at a given point in time.

The relevance of these considerations has been illustrated by a number of papers given at this meeting. We present here a comparison of a number of "historically interesting" data sets and show that the conclusions reached have frequently not been justified.

FRANCE - COLD FUSION BY SPARKING

J. Dufour (Shell Research/CNAM, Lab. des Sci. Nucl., Paris), J.P. Millot, J. Foos (CNAM Lab. des Sci. Nucl., Paris), "Interaction Palladium/Hydrogen Isotopes, Cold Fusion by Sparking in Hydrogen Isotopes," ICCF-5, April 3-19, 1995, Monte-Carlo, Monaco, Book of Abstracts, # 604.

AUTHORS' ABSTRACT

In previous communications[1,2], we described excess power generation observed when sparking in an hydrogen isotope (H_2 or D_2), one of the electrodes in contact with the gas being made from palladium or stainless steel. The calorimetric system consisted of 3 calorimeters.

We have built and run an improved calorimetric system, that allows a complete energy balance to be made when using only one calorimeter, which contains the reactor and the high voltage generation system. This allows very reliable measurement to be made of the excess power generated.

We have measured excess powers up to 7 watt, both on H_2 and D_2, representing 25 to 30% of the power invested in the electrical discharge that sustains the process.

A search for nuclear by-products has been carried out, with the following main results:
- very small amounts of ^{4}He and of ^{3}He have been identified that are difficult to explain by obvious artifactors.
- very small amounts of neutrons (2 times the background) have also been observed.
- no tritium above background has been found.
- copious emission of low energy (50 to 200 KeV) γ photons have been observed in unusual conditions of the reactor (fast variations of temperature).

From this data, we conclude that part of the excess energy we have measured is not of nuclear origin and probably comes from the formation of tightly bond hydrogen atoms, as proposed by various authors [3,4].

To explain the formation of the nuclear by-products we observe, we have put forward 2 possible explanations that we are currently testing experimentally.

All results will be disclosed and discussed in our communication.

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FRANCE - POSITIVE FEEDBACK & BOILING

S. Pons and M. Fleischmann (IMRA S.A. Science Center, Sophia Antipolis), "More about Positive Feedback; More about Boiling," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #204.

AUTHORS' ABSTRACT

We have explained elsewhere [1,2] that the behavior of the Pd/H and Pd/D systems at high H/Pd and D/Pd ratios can be

explained by the onset of "positive feedback." As far as the Pd/D system is concerned "positive feedback" leads to an increase in the rate of excess enthalpy generation with increase of temperature; one factor leading to "positive feedback" is probably a change over from exothermic to endothermic absorption of D with increase of the charging ratio.

In this paper we show how the onset of "positive feedback" can be recognized when carrying out measurements using isoperibolic calorimetry. By contrast, "blank experiments" only show negative feedback (experiments on the Pd/D system show both positive and negative feedback). If the temperature is allowed to rise following the onset of "positive feedback," cells will eventually be driven to the boiling point provided the cell design is correctly adjusted to take account of the required thermal fluxes. High specific rates of excess enthalpy generation can then be achieved. In effect the experimental protocols become part of the parameter space of the system.

Using appropriate case studies, we also illustrate how the behavior of "cells being driven to boiling" can be interpreted using no arbitrary assumptions and independently of any methods of calibration.

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[1] M. Fleischmann, S. Pons, Monique Le Roux and Jeanne Roulette, *Proceedings of ICCF-4,* EPRI TR-104188-VI Project 3170, p 1-1.
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FRANCE - ANOTHER COLD FUSION?

P. Rothenburger (Faculte des Sciences et Techniques), S. Walter (Ecole Nationale Superieure de Chimie de Mulhouse, Mulhouse Cedex), "Paraire's Patent: Another Way to Cold Fusion?" presented at the 5th International Conference on Cold Fusion, Monaco, 9-13 April 1995.

AUTHORS' ABSTRACT

In 1970 there appeared in the Bulletin Officiel de la Propriete Industrielle a patent presented by Paraire six years earlier. He described the formation of helium 3 obtained by strong electric discharge phenomena through a copper wire in deuterium atmosphere. Our first aim was to investigate these observations, in order to control the previous results described by Paraire.

Our work had to be carried out with poor means, just with borrowed instruments, private financing and without any public support. Thus, we had to transform the only alpha detector we could use in order to detect the expected neutron radiation corresponding to the fusion phenomena. Therefore we coated the window of the alpha detector with fine boron powder.

Our first investigations lead to negative results, since no emission of alpha particles was observed. At this point, we assumed the particles of mass 3 observed by Paraire to be HD molecules formed by cracking and recombination of both H_2 and D_2 molecules (since absolutely pure deuterium was certainly not available for his experiments) in the strong transient electromagnetic field near the copper wire. By modifying the discharge conditions, we obtained finally a huge, out of scale signal of our alpha detector when the discharge was carried on with a 4 μF capacitor charged at 10 kV. The discharge showed a pseudoperiod of about 10^{-7} s.

However, we could not completely neglect the hypothesis of an artifact due to the strong variations of the electromagnetic field near the detector (ZnS / Photomultiplier type). Therefore, we need the use of a well fitted neutron detector. To this date, work is being done this way.

INDIA - TRITIUM GENERATION WITH Ni

T.K. Sankaranarayanan, M. Srinivasan, M.B. Bajpai and D.E. Gupta (Chem. Engr. Div. & Neutr. Phys. Div., Bhabha Atomic Res. Ctr., Trombay, Bombay), "Evidence for Tritium Generation in Self-Heated Nickel Wires Subjected to Hydrogen Gas Absorption/Desorption Cycles," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #307.

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. (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/deloading H_2 gas, the wire was raised to glow hot conditions under a vacuum of 10^{-5} cm of Hg, while for loading, Iolar grade H_2 gas at subatmospheric pressure was introduced into the cell. After several trial runs, an appropriate protocol for activating the Ni surface and obtaining a maximum rate of absorption was established. As recommended in the literature, repeated cycles of loading/partial unloading were carried out to increase the net

absorption of H_2 into the wire. A maximum net loading of over 0.3% by weight of the nickel wire could be obtained after about a week of pressure/temperature cycling.

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 the tritium content. For this, 1 ml of the distilled sample was added to the scintillation cocktail. So far, 6 out of 9 loaded wires have indicated generation of tritium. However, not all the cut pieces from a given wire indicated presence of 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 8 pieces have shown tritium, in the range of 1 to 2,700 Bq. For the lowest activity case of 1 Bq/5 ml, the count rate was ≅10% above the background value of ≅250 counts/10 mins. The maximum amount of tritium production, namely 2,700 Bq, was observed in one 11 cm segment of a 45 cm long wire which displayed exceptional absorption/desorption characteristics in terms of both rate as well as quantity of H_2 absorption (>3% of Ni wire weight). In case of one of the cut pieces of another sample wherein the surface layers were leached out separately prior to dissolving the balance portion, both the solutions indicated presence of tritium. 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.

One cut piece from a loaded nickel wire when, exposed sandwiched between two photographic films, gave weak but identical spotty autoradiographs, in both the upper and lower films. The present results thus corroborate production of tritium during electrolytic loading of natural hydrogen into nickel cathodes, first reported by us at ICCF-3 (Nagoya) and confirmed subsequently at ICCF-4 (Maui).

Calorimetric measurements carried out to date during loading/unloading cycles with some of the wires have not revealed any anomalous heat generation in excess of V*I supplied to the nickel wires. Various techniques of "triggering" excess heat are presently being explored.

INDIA - TiD_x WIRE WITH D_2 CONCENTRATION

V.K. Shrikhande (Tech. Phys. & Prototype Engr. Div., BARC), T.C. Kaushik, S,K.H. Auluck, A. Shyam and M. Srinivasan (Neut. Phys. Div., BARC, Bombay), "Preliminary Results on the Variations of Electrical Resistance of a TiD_x Wire with Deuterium Concentration," presented at the 5th International Conference on Cold Fusion, Monaco, 9-13 April 1995.

AUTHORS' ABSTRACT

To understand the causes of irreproducibility of earlier observations of tritium in titanium deuteride (TiD_x) systems, we have been conducting experiments to look at the behavior of electrical resistance of TiD_x wires as a function of the deuterium concentration (D/Ti). The samples are taken in the form of 60 mm long, 250 μm diameter titanium wires (Goodfellow Metals, 99.6% purity) which are cleaned in an acid mixture, weighed and mounted inside a glass chamber by spot welding to tungsten feed-throughs. A D.C. current of 1.2 A is passed through the wire to ohmically heat it to a glowing temperature in a vacuum of 10^{-6} mbar or better. After the current is switched off and room temperature is attained, the wire resistance (R_0) is measured using a four probe resistance meter with a ±0.2% accuracy. Afterwards the deuterium gas is filled in the glass chamber to pressure of 200 mbar and loading is carried out in a series of steps. In every cycle, the wire is heated for some time until a measurable quantity of gas is absorbed and is then allowed to cool down. Its resistance (R_1) and the decrease in the chamber pressure are measured (using an oil manometer) at room temperature. The latter quantity enables calculation of D/Ti ratio from the measured system volume and sample mass.

Significantly, we observe that an apparently simple property like the resistance is also non-reproducible. The results show that the value of R_0 varies from sample to sample although they have the same length, are taken from the same stock and are subjected to identical treatment. The value keeps on increasing if the sample is subjected to repeated heating and cooling cycles in vacuum (10^{-6} mbar), tending to stabilize after about 10 cycles. The variation of R_1/R_0 as a function of D/Ti is seen to behave differently for each sample. We suspect that the residual gas is playing an important role.

To minimize the effect of residual gases in the vacuum, the experiments have been repeated by degassing the sample in ultra-high vacuum produced using a Cesium getter which is sealed off just before the introduction of deuterium. By limiting this procedure to one cycle only, both R_0 and R_1/R_0 vs D/Ti are observed to be quite reproducible. To our knowledge, this is the first reproducible measurement of the resistance ratio of TiD_x wire as a function of deuterium concentration. One of the implications of these preliminary results is that the resistance ratio method may not be suitable for estimating the deuterium loading ratio in titanium.

ITALY - OVERUNITY AT ENEA FRASCATI

L. Bertalot, A. De Ninno, F. De Marco, A. La Barbera, F. Scaramuzzi, V. Violante (ENEA, Frascati), "Power Excess Production in Electrolysis Experiments at ENEA Frascati,"

ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #202.

AUTHORS' ABSTRACT

Continuing the activity on excess heat detection during the electrolysis of heavy water with palladium cathodes, previously reported at ICCF-3 and ICCF-4, new experiments have been performed with success, and the connection between the power excess production and other parameters of the experiment has been clarified. This will be reported in this communication. Another problem that is being addressed in our laboratory is the measurement of the D/Pd ratio through the measurement of the cathode's resistance. Finally, the circuit for the detection of helium in the gases evolving from the cell, using a high-resolution mass spectrometer, is being completed and preliminary results may be presented.

ITALY - POSSIBLE PHASE TRANSITION

Francesco Celani, Antonio Spallone, Paolo Tripodi, Alessandra Petrocchi, Daniele Di Gioacchino (INFN, Laboratori Naz. di Frascati), Paolo Marini, Vitrorio Di Stefano (SKITEK, IRI, Pomezia), Sandro Pace (INFM, Dip. Fisica, Univ. Salerno), Marco Diociaiuti (ISS, Roma), and Alfredo Mancini (ORIM S.R.L., Macerata), "High Power μs Pulsed Electrolysis using Palladium Wires: Evidence for a Possible Phase Transition under Deuterium Overloaded Conditions and Related Excess Heat," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #206.

AUTHORS' ABSTRACT

We have tested thin and long pure Palladium wires (diameter between 100 and 500 μm, length between 5 and 100 cm), some covered by lead (thickness up to 5 μm), using high power μs pulsed electrolysis (peak current up to 120 A, pulse width equal to 800 ns, repetition rate between 1,000 and 20,000 Hz) in a 0.3 N and 0.01 N LiOD - D_20 solutions. The lead was used both in order to increase the overvoltage of the Pd-Deuterium system and to reduce the deloading of the deuterium from Palladium between power pulses.

The experimental set-up was quite unusual: we have connected the nickel anode to the ground and only one side of the wire, used as a cathode, to the pulse generator, in a coaxial configuration, while the other side has been left floating. We have performed the electrolysis only with a fraction of the total length of the wire: in particular we used 5/20, 5/50 and 5/100 of the wire length. We have measured the difference of potential dV_{peak} between the two sides of the wire in order to evaluate in situ the resistance behavior with time, given by dV_{peak}/I_{peak} during the power pulse. We have measured both the side of the wire under electrolysis and the other just immersed in the LiOD - D_20 solution.

We have obtained quite reproducible results for the excess heat and some correlations between the excess heat and electrical parameters of the system. To calibrate the excess heat, we have adopted the procedure of "self-calibration" using an internal heater. It was powered cyclically, every six hours, at 1W. In some experiments, the excess heat reached the value of 6W, greater than 100% of the input power.

In the experiment with pure 100 μm Pd wire we observed, by in situ on line resistance measurements, that the time necessary to overcome the 0.8 D/Pd ratio is as short as 200 s. After the wire resistance reaches the maximum value it gradually drops down to a value correspondent to a D/Pd value of about 1.1 and suddenly jumps to the maximum value (0.8 D/Pd). This is a periodic phenomenon with a time constant of about 80 s in our experimental conditions.

ITALY - NEUTRON ENERGY MEASUREMENTS

Claudio Manduchi (Dip. Fisica, Univ. Padova), "Neutron Isochronous Flight Path Spectrometer," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #301.

AUTHOR'S ABSTRACT

Neutron energy measurements play an important role in diagnostics of fusion reactions. In particular, the production of neutrons in cold-fusion phenomena is generally considered as the unambiguous signature of nuclear interactions, and the neutron energies are indicative of the particular reactions involved.

From the distribution of scattered neutron flight-times (TOF) between two organic scintillators, the spectrum of energies can be deduced. If the neutron intensities are very low, it may be necessary for the second detector to subtend a large solid angle at the scatter (first) detector, causing a spread in the angle of scattering of neutrons detected by both scintillators. To reduce the resulting uncertainty in the measured energies, we have constructed a self-contained TOF spectrometer incorporating the notion of isochronous surfaces. This allows the use of a secondary counter which subtends a large solid angle and a relatively long primary scatterer, producing a considerable increase in efficiency.

The principle of the arrangement of the spectrometer considers the length d of the neutron flight-path and the energy E'_n of the scattered neutron: the flight-time is determined by:

$$^tTOF = d(m/2\ E'_n)^{½}$$

where m is the neutron mass. The incident energy E, and the energy E'_n after scattering are related by:

$$E'_n = E_n \cos 2\theta,$$

where θ denotes the scattering angle. It is seen that the dependence of tTOF on θ may be removed if the second scatterer is shaped such that $d = D \cos\theta$. This is the equation of a spherical surface of diameter D.

In the present instrument, the diameter D of the spherical surface is 10 cm, as a reasonable compromise between efficiency of neutron detection and limits of resolution. The start detector is a NE-213 cylindrical scintillator particularly favored by pulse shape γ discrimination. The stop detector is an hemispherical shell of NE-102A scintillator with mean diameter D, opposite to the scatter detector.

The time resolution width of the spectrometer ($\cong$ 1.8 nsec) is mainly due to the finite sizes of the detectors, and timing spread in scintillators and electronics. The efficiency of the spectrometer for neutrons in the region from 0.7 to about 8 MeV is better than 1%.

The main advantages of this instrument are relatively high efficiency, very low background, and simple data analysis.

ITALY - (QUASI) IONIC STATE OF D_2

G. Mengoli, M. Fabrizio (CNR-IPELP, Italy), C. Manduchi, G. Zannoni (Dipartimento di Fisica dell'Univ. di Padova, Italy), "Absorption/desorption of Deuterium at Pd and Pd/Au Electrodes: Indications of the (Quasi)Ionic State of Deuterium at the Metal/Electrolyte Boundaries," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #507.

AUTHORS' ABSTRACT

This investigation focuses on the anodic extraction at room temperature of deuterium from Pd deuterides prepared electrolytically in D_2O containing various concentrations of LiOD. The coulometry of the extraction accounts for the D/Pd atom ratios achieved after electrochemical insertion, while the rate of the extraction (i.e. the density of the anodic current) gives information on the thermodynamic of deuterium either in the bulk Pd or at the Pd/electrolyte boundaries. The concentration of the electrolyte has low effect on the extent of Pd → PdD_x conversion as the maximum D/Pd achieved at any concentration (0.1-1.0 M) are similar. The rate of the extraction is found to be controlled by both deuterium diffusion within the metal and kinetics steps at the boundaries: the kinetic control, which prevails in the initial stage of PdD_x oxidation, does depend on LiOD concentration. Analysis with a suitable algorithm of the extraction current transients reveals the relevant diffusion and kinetic parameters. Fig. 1 shows the diffusion coefficient D* dependence of the loading ratio D/Pd: the large increase of D* with D/Pd is likely due to large increase in thermodynamic potential paralleling the high deuterium loading into Pd lattice.

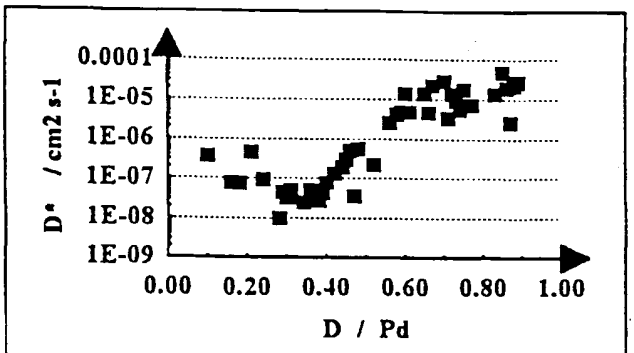

Fig. 1. Averaged diffusion coefficient values D at various stoichiometric ratios D/Pd (25 °C)

The kinetic parameters show that the rate of (electro)chemical steps at the boundaries increases with LiOD concentration: the higher the alkalinity the easier deuterium extraction is, which may indicate that the (quasi)ionic state predicted for the absorbed deuterium is retained also by surface adsorbed deuterium. To go more deeply into this phenomenon, the electroless deposition of gold onto PdD_x has been investigated. The process, formally accounted for by the reaction:

$$PdD_x + DO^- + AuCN \rightarrow Pd/Au + D_2O + CN^-$$

leads to coherent, adhering coating which can grow several μm thick. Deuterium desorbing from Pd lattice does not appear to be the direct reducing agent of Au ions diffusing from the solution: in fact, as soon as Au coating has grown some hundred Å thick, it likely becomes impervious to atomic and molecular deuterium. Therefore, PdD_x is viewed as the direct electron source to reduce Au ions. As electrons are transferred, an equivalent number of deuterons must be freed to the environment: initially straightaway into the solution, but in a later deposition stage via the Au coating itself. In other words the (quasi)ionic state of deuterium would extend from PdD_x into the outer Au layer. This view is strengthened by the electrochemical features of PdD_x/Au/electrolyte interface: the electrochemical driving of deuterium in and out the underlying Pd proves to be by no means hindered by coherent Au coating.

ITALY - SEARCH FOR ^{4}He PRODUCTION

E. Botta[1], R. Bracco[2], T. Bressani[1], D. Calvo[1], V. Cela[2], C. Fanara[2] and F. Iazzi[3] ([1]Dip. Fis. Sperimentale, Univ. Torino

and INFN Sez. Torino; [2] FIAT COMPES, Torino; [3] Dip. Fis., Politecnico di Torino), "Search for ^{4}He Production in Pd/D_2 Systems in Gas Phase," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #323.

AUTHORS' ABSTRACT

^{4}He production is considered one of the most convincing signatures of nuclear fusion possibly occurring in metal lattices loaded with H_2/D_2. Unambiguous detection of ^{4}He is, however, rather difficult, since it requires the use of high resolution mass spectrometers operating at high sensitivity, and great care is needed to avoid sources of errors due to small contaminations from the atmosphere.

We designed, tested and operated a cold fusion cell directly coupled to an ULVAC HI-RESOM mass spectrometer. Fig. 1 of the paper gives a scheme of the apparatus and Fig. 2 the instrumental mass resolution obtained at A = 4. A rather complete series of measurements has been performed with Pd samples in form of sheets, 8 x 1 x 0.005 cm^3, immersed in a D_2 atmosphere (0.5 ÷ 2 bar). A steady current exceeding 50 A circulated in the sheet, producing an electric field of ~ 0.2 V/cm. In such a way we tried to increase the loading ratio α = D/Pd beyond the thermodynamical value 0.67 at NTP. α was determined with a precision of ± 2% either by means of the thermodynamic parameters and by electrical resistance values. In most of the experiments we used Pd sheets with gold-coated edges (300-400 nm thickness), that may favor the confinement of deuterons in selected regions. We measured in some of the experiments an increase of α, and we have also indication of some ^{4}He production. Further analyses and experiments, in particular with D_2/H_2 mixtures are planned and the results will be presented.

ITALY - ^{4}He MEASUREMENT IN GAS PHASE OF CF

Guido Gigli, Giovanni Balducci, Riccarda Caputo and Daniele Gozzi (Dip. Chim., Univ. "La Sapienza", Roma), "On and Off Line Helium-4 Measurement in the Gas Phase of Cold Fusion Electrochemical Cells," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #325.

AUTHORS' ABSTRACT

The quantitative measurement of the ^{4}He concentration in the gaseous products of a cold fusion electrolysis experiment[#] will be reported. The off line determination by a magnetic mass spectrometer is a sequel of the experiment already described at ICCF-4[1,2]. An on line detection of the ^{4}He content in the gas phase has been recently added to the experiment with our multicell setup. A Balzers quadruple mass spectrometer, operated at a resolution capable of separating ^{4}He and D_2 is employed. A detection limit at the ppb level was attained by operating the on line sampling in a discontinuous way and yet preserving the capability to follow the time dependence of the ^{4}He and D_2 concentration. Improvements were made to the experimental assembly in order to avoid air contamination which is checked in both on and off line determinations by monitoring the Neon content through the $^{20}Ne^{++}$ ion measurement.

References
[1] D. Gozzi et al., *J. Electroanal. Chem.*, 379 (Dec. 1994)
[2] D. Gozzi et al., *Helium-4 Quantitative Measurements in the Gas Phase of Cold Fusion Electrochemical Cells,*EPRI REPORT TR-104188-V1, Palo Alto, CA, vol. 1, p. 6-1/6-19 (1994)

Work carried out by the financial support of the National Research Council (CNR) and University of Rome La Sapienza.

Details on these measurements will be presented in a companion communication at this meeting.

ITALY - NEUTRON EMISSION

G. Mengoli, M. Fabrizio (CNR IPELP, Italy), C. Manduchi, and G. Zannoni (Dip. Fis., Univ. di Padova), "Neutron Emission from Transient and/or Steady-non-Equilibrium States of Pd Deuterides," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #310.

AUTHORS' ABSTRACT

This communication deals with the detection of neutrons from the following three experimental configurations:

- deuterium loading into Pd-Rh alloy by gas-metal reaction;
- electrochemical insertion into Pd-Rh alloy;
- application of *dc* current and/or external electrostatic fields to Pd deuteride.

Deuterium loading into alloy sheets (Pd95%-Rh5%) was carried out isochorically under sub-atmospheric D_2 by decreasing the temperature from 900°C to 20°C in about 30 hours. Some fluctuating absorption occurred with reduction of the temperature but most of the absorption was measured at 20°C, at which the attained D/metal atom ratio (0.79±0.03) was found to exceed the values typical of pure Pd. The interaction between D_2 and the alloy at the various temperatures was monitored by a NE213 liquid scintillator n-spectrometer, placed outside the reaction chamber and maintained isothermal to avoid temperature effects on the detector.

Although neutrons could be detected even at the highest temperatures, reproducible neutron emission occurred at the beginning of Pd alloy → ß deuteride phase transitions, whereas the phenomenon tended to quench as soon as the alloy was fully loaded. When the deuteride samples were heated from 20°C to 900°C, neutron emission was again measured during thermal decomposition (<100°C). The neutron emission rate averaged for 24 hours ranged between 1 to 1.5 n s^{-1}, with transient peaks of 7-8 n s^{-1}(4-5σ). The electrolytic insertion into alloy sheets was carried out in alkaline electrolytes.

The maximum D/Me achieved at 25°C (0.80±0.93) was found to increase with the alkalinity; the thermal decomposition (at 90°C) of the alloy deuteride required several days, which points to D_2 egress from the metal being much more hindered in the electrolyte than in the metal-gas environment. Neutron emission was measured at any time (ten runs out of ten) when the alloy was being converted into ß deuteride, whereas the emission faded at ß transition completion. The energy of the emitted neutrons was high, 2.45 MeV (?) and above, and the neutron emission rate averaged for 24 hours ranged between 0.2-0.7 n s^{-1}(2-3σ).

During prolonged electrolytic runs further neutron emission, correlated with thermal stimulation of the sample, could be evidenced. Direct constant current was made to flow through Pd deuteride strips to establish a steady migration of deuterium within the Pd lattice. Indeed, the concentration of deuterium (from resistance measurements) was seen to increase along the strip from the positive to the negative pole of the current; however, **very large D/Pd ratios could be achieved only when external electrostatic fields were applied to the sample**, as the induced surface charge was probably catalyzing further D_2 absorption.

The *dc* current flow was at any time paralleled by strong neutron emission (30 to 40 n s^{-1} as averaged for 24 hours) which was thus correlated with the migration of deuterium, but had low dependence on the concentration in the sample. The discrimination in energy of the emitted neutrons by a time of flight n-spectrometer indicated that neutrons of energy ≤ 2.45 MeV account for only ≅ 20% of the total, all the other neutrons having higher energy; neutrons emitted with a given energy do not seem to be time correlated with those of different energy. A cause-effect relationship is therefore established between neutron emission and migration and/or diffusion of deuterium within Pd; however, we cannot decide whether the D-D fusion probability increases owing to the drift of deuterons or whether neutrons are emitted because of deuteron collisions with the guest lattice atoms.

ITALY - FERMI UPGRADE

B. Stella, A. Asmone, M. Corradi, F Ferrarotto (INFN Roma 1 and Dip. Fis., Univ. Roma III, Univ. "La Sapienza," Roma), F.F. Kayumov, B.N. Lomonosov, G.I. Merzon, D.I. Minasyan, V.A. Tsarev (P.N. Lebedev Phys. Inst., Rus. Acad. Sci., Moscow), F. Celani, A. Petrocchi, A. Spallone and P. Tripodi (Lab. Naz. INFN, Frascati), "Upgrade of the FERMI Apparatus with Detection and Identification of Charged Hadrons in the Few MeV Energy Region," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #302.

AUTHORS' ABSTRACT

The FERMI apparatus (situated in the under-rock Gran Sasso INFN Laboratory) is mostly a neutron moderator-detector developed for cold fusion researches, with 40%-8% detection efficiencies for neutrons in the 1 KeV - 20 MeV energy range (25% at 2.5 MeV), low background, pulse shape acquisition, good time resolution for neutron bursts, good reconstruction of the average original neutron energy. Gamma rays are detected mostly by a low noise NaI scintillator with 26% acceptance. The system response is verified by a full MC simulation, experimentally tested.

The samples are put in the central axial gap. Aside, close to the sample (a thin Pd cathode and wall of a specially designed electrolyser), a system for detection of charged particles (two MWPC with He-CH_4 gas mixture and a thin CsI scintillator) can be [used] to measure dE/dx and E (<4% resolution of the final reconstructed energy) providing the identification of hadrons in the range 1-10 MeV kinetic energy. On line tests and calibrations are performed by an α source and by the ≤3 MeV protons diffused by the α's on a mylar window. A triple coincidence (background less than one hadron per day) triggers the data acquisition for charged particles.

The complete FERMI system has now the capability to detect multiple time correlations and identify and measure the energy of neutrons, gamma's and protons, alpha particles, unexpected light nuclei, to measure the tritium content (off line) and to monitor thermal effects and deuterium loading. The search for atomic ^{4}He could be established in the future.

The detailed performances will be presented at the conference, possibly together with results of searches for nuclear ashes.

ITALY - DEUTERIUM CONFINEMENT IN Pd

Daniele Gozzi, Giovanni Balducci, Riccarda Caputo, Fabio Cellucci, P. Luigi, Cignini, Guido Gigli, Massimo Tomellini (Dip. Chim., Univ. "La Sapienza," Roma), Salvatore Frullani, Evaristo Cisbani, Franco Garibaldi, Mauro Jodice, and G.

Maria Urciuoli (Lab. Fis., Ist. Sup. di Sanita, Roma), "Deuterium Confinement in Palladium: In Situ Measurements of Excess Heat and Nuclear Products," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #322.

AUTHORS' ABSTRACT

The six-year activity on cold fusion of our research group continues having as its main objective the understanding of the phenomena involved in the confinement of hydrogen isotopes in metal matrices. Our attention was and is particularly focused on continuous improvement of the reliability of measurements of ^{4}He, neutrons and tritium related to the heat excess findings. Our most recent results showed that the energy balance between heat excess and ^{4}He recovered was satisfied within the experimental errors and a very intriguing time pattern was found [when] the heat excess generation preceding the ^{4}He release. On the other hand, simultaneous mass spectrometric determinations of ^{20}Ne showed that some air contamination could be present.

Therefore, the experiment we intend to present here has been designed to exclude any possibility of air contamination. In fact, each of the four electrochemical cells works in a ^{4}He-free atmosphere (^{4}He concentration below 0.01 ppb) created by boiling off LN_2 and, in the gas mixture escaping from each cell, ^{4}He is measured on-line by our high resolution quadrupole mass spectrometer.

All the cells have cathodes of a new design to allow a better D confinement through the technique we developed since 1989, based on the charged status of hydrogen isotopes in some metal matrices. Further improvement of our experiments is constituted by a new design of the calorimetric cells which is expected to have a detection limit an order of magnitude lower compared with the previous cells used.

ITALY - IN REPLY TO CRITICISM

Giuliano Preparata (INFN, Sezione Di Milano, Milano,), "Setting Cold Fusion in Context: a Reply," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, # 401.

AUTHOR'S ABSTRACT

After five years of Cold Fusion (CF), while the experimental panorama seems to be somewhat stabilized, the theoretical understanding appears in a "Babylonian" state.

I shall argue that this unpleasant state of affairs is due to the unwillingness of the majority of CF theorists to face a number of realities that have been identified and spelled out in detail in a paper by Fleischmann, Pons and myself (Nuovo Cim. vol 107A, 1994, p 143), already two years ago.

Taking off from this paper, that sets CF in context, I shall give a reply to the many critiques that have been made, directly or indirectly, to my work, based on a new paradigm of condensed matter, that, unlike the generally accepted one, makes full use of QED coherence.

ITALY - CRYOGENIC LOADING METHODS

F.F. Kayumov, S. Hodyrev, B.N. Lomonosov, D.I. Minasyan, V.A. Tsarev (P.N. Lebedev Phys. Inst., Rus. Acad. Sci., Dip. Fis., Univ. di Roma III, INFN Roma), F. Celani, A. Spallone, P. Tripodi (Lab. Naz, INFN - Via E.Fermi, Roma), A. Asmone, M. Corradi, F. Ferrarotto, B. Stella (INFN Roma), "Attempts of γ Phase Pd Loading up to D/Pd-1.33," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #502.

AUTHORS' ABSTRACT

Following an experiment at Moscow Crystallographic Institute, where Pd hydrogen loading up to H/Pd=1.33 was achieved with cryogenic methods (resulting in a stable state at room temperature), we are trying to reproduce the results this time with deuterium and with macroscopic thickness and larger dimensions. SEM images show a peculiar structure with smaller interatomic distances compared with alpha and beta phases. The samples will be compared with other ones electrolytically loaded by a pulsed (rise time< 1 μsec) high current generator.

ITALY - DEUTERON COLLISIONS

V. Violante, A. De Ninno (CRE ENEA Frascati), "`Collision' Between Two Deuterons in Condensed Matter," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco.

AUTHORS' ABSTRACT

The behavior of ions confined by means of electro-dynamic containment around palladium lattice tetrahedral sites is discussed. Ion electro-dynamic confinement is known to be strongly influenced by the initial conditions and the system parameters. The system under consideration is a lattice trap for deuterons with the supposition that they occupy the tetrahedral sites over a certain concentration range. The electron motions seem to have a dominant role in the dynamics of two deuterons moving around such lattice sites. A mathematical model allows us to describe, via a computer

simulation, the deuteron dynamics and reveals an approach mechanism that could strongly decrease the mean distance between two positive charges embedded in a lattice.

JAPAN - CATHODES & SPILLOVER DEUTERIUM

Y. Arata and Y.C. Zhong (Univ. of Osaka, Japan), "Utilization of `Spillover-Deuterium' in Double Structure (DS) Palladium Cathodes," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #601.

AUTHORS' ABSTRACT

It was verified that a new kind of energy is caused by "Spillover-Deuterium" generated in a double structure (DS)-cathode with "Pd-black." Using this cathode, the authors confirmed the sustained production of a significantly abnormal amount of energy over a period of several months that could not be ascribed to chemical reaction energy. The chemical reaction energy of 0.1 mol·Pd-black used is only 4 kJ, but more than 200 MJ of excess energy was continuously produced for over 3,000 hr. at an average rate of 50-100 kJ/hr. using a DS-cathode with a same quantity of Pd-black. Intermittent operation over a period of two years using this structure proved the complete reproducibility of these results.

JAPAN - SONOFUSION

Kenji Fukushima (Phys. Dept., Joetsu Univ. of Ed., Niigata), "The Stability of Bubbles Induced by Supersonic Field - Sonofusion," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #608.

AUTHOR'S ABSTRACT

As well known, a supersonic field induces the cavitation in a liquid and then created cavities radially oscillate in phase with the applied supersonic pressure field. In their contraction phase the gas content is greatly adiabatically compressed and as a result a spot of high temperature and high density is created in the liquid. The sonoluminescence phenomenon provides us a direct evidence for the formation of the hot spot.

Flint and Suslick[1] succeeded in directly measuring the temperature of a hot spot in a silicon oil by analyzing the spectra of the luminescence from C_2 and obtained the value $T = 5{,}075 \pm 156$ K. After a year Hiller, Putterman and Barber[2] obtained the hot-spot temperature $T \sim 6$ eV, by fitting the spectra of the luminescence from an air bubble in water to those of black-body radiation.

Nowadays, it is widely believed that the hot-spot temperature may reach one hundred thousand Kelvin. We are very interested in what extreme states can be realized under ambient conditions, especially in connection with the effort of searching for the possible mechanism of cold fusion. The determination of the utmost limit of the hot-spot temperature constitutes, therefore, the one of most urgent scientific subjects. We attacked this problem by use of the bubble dynamics[3-4], which had been developed for about fifty years since the discovery of the sonoluminescence phenomenon.[5-7]

We assumed that a cavity of radius R_O was initially in a dynamical equilibrium with an ambient pressure and a supersonic field $p(t) = -pA\sin\omega_A t$ was applied at $t = 0$, where $P_A = 4$ bar and $\omega A = 15$ kHz. It was remarkable that the T_{max} exceeded 10^8 Kelvin when R_O was less than 10 micron. This temperature is high enough to cause the hot fusion if a gas content is deuterium.

Not to say, we have made a lot of simplifications in the calculation, that is, ignored the compressibility and bulk viscosity of a liquid and assumed the stability of a spherical cavity, the spatial uniformity of a gas content and so on. The above statement thereby should not be literally accepted.

In this paper we examine the stability of a cavity against the disintegration, as a next step to more precise conclusion.

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[5] K. Fukushima, Frontiers of Cold Fusion, edited by H. Ikegami (Universal Academy press, Tokyo, 1992), p 609-612.
[6] K. Fukushima and T. Yamamoto, Cold Fusion Source Book, edited by Hal Fox (Fusion Information Center, Salt Lake City, 1994).
[7] K. Fukushima and T. Yamamoto, Proceedings of International Symposium on Cold Fusion and Advanced Energy Sources, (Belarusian State University, Minsk, Belarus, May 24-26, 2994), p 197-202.

JAPAN - ENERGETIC PROTON & γ EMISSION

J. Kasagi, T. Ohtsuki (Nucl. Sci. Lab., Tohoku Univ.), K. Hiraga (Dept. Chem., Tohoku Univ.), K. Ishii (Cyclotron and RI Center, Tohoku Univ.), "Energetic Protons and α Particles Emitted in Low-Energy Deuteron Bombardments of Various Metals," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, # 326.

AUTHORS' ABSTRACT

In low-energy deuteron bombardments of TiD_x, we have observed energetic charged particles which cannot be explained as emitted by the usual nuclear reactions. They are protons with energies up to ≅17 MeV and α particles with energies up to ≅6.5 MeV, and they were suggested to be emitted in reactions involving three deuterons. We have continued the measurements to get more detailed information.

The experiments have been carried out using a deuteron beam obtained from the Cockcroft-Walton accelerator at the Department of Chemistry at Tohoku University. Charged particles are measured during the irradiation of deuterons with bombarding energies from 90 to 170 keV. A ΔE-E counter telescope was used to identify charged particles. Various metal plates (Al, Au, Cu, Pd, Pt, Ti, Zr and Zn) were bombarded, the deuterons being concentrated during the bombardment. In a series of measurements, we have made the following observations:

As expected, protons from the D+D → p+T reaction are major products in the bombardments. At the beginning of the bombardment, the reaction rate of the D+D reaction increases in proportion to the total dose of the deuteron beam; the deuteron density in the metal plate depends linearly on the total dose. However, the increase of the reaction rate becomes small as the total dose increases, and finally the reaction rate becomes constant. This fact suggests a saturation of deuteron density in metal. The saturated reaction rate depends greatly on the nature of the metal; for example, the observed reaction rate is much larger for a Pt target than for a Ti target. In the bombardment on Pt, high energy protons as well as α particles are observed. In a proton spectrum, a broad bump ranging from 12.5 to 16.5 MeV and a continuum up to ≅17 MeV are clearly seen in addition to the large peak due to the D+D → p+T reaction. Alpha-particles with energies up to ≅6.5 MeV are also seen in a two-dimensional ΔE-E spectrum. These characteristics are very similar to the spectra obtained in the bombardment on TiD_x. Thus, the present observation strongly suggests that the nuclear reactions involving three deuterons occur more commonly in metals in which deuterons are heavily concentrated.

JAPAN - ALKALI METALLIC ION SOLUTIONS

Reiko Notoya (Catal. Res. CTR., Hokkaido Univ., Sapporo), "Nuclear Products of Cold Fusion Caused by Electrolysis in Alkali Metallic Ion Solutions," ICCF-5, Monte-Carlo, Monaco, April 9-13, 1995, Book of Abstracts, # 609.

AUTHOR'S ABSTRACT

In ICCF-3 and -4, the author reported that the generation of calcium and tritium species were certainly occurring in the electrolytic cells with potassium carbonate solutions, accompanied with extraordinarily large heat evolution. Consecutively, large excess heat was observed in light or heavy water solutions of the other alkali species as well, in the same way. The simultaneous observation of gamma ray and neutron emission, and the analysis of electrolytes by ICP-MS were added to the above experiments. It was confirmed that in the boundary and the solid phases, some nuclear reactions were occurring among the intermediates of the hydrogen evolution reaction, i.e. the intermetallic compounds between alkali metals and electrode materials, and hydrogen atomic species. And further the above results indicated that the neutron capture of alkali species also took place in these electrolytic cells.

JAPAN - IMPORTANCE OF Pd LOADING

N. Hasegawa, M. Sumi, M. Takahashi, T. Senjuh and N. Asami (NHE Lab., Inst. of Appl. Energy, Sapporo), "Electrolytic Deuterium Absorption by Pd Cathode and a Consideration for High D/Pd Ratio," ICCF-5, Monte-Carlo, Monaco, April 9-13, 1995, Book of Abstracts, # 510.

AUTHORS' ABSTRACT

It is often pointed out that high loading ratio (D/Pd ratio) over 0.85 is necessary to be reached to observe the Fleishmann/Pons effect on an excess heat generation with high reproducibility during an electrolysis of heavy water with Pd electrode. Since it is not easy, however, to attain high loading ratio by an ordinary electrolysis method, several organization have succeeded to reach it. But definite conditions are hardly enough established still now. Thus it is much important to make the mechanism clear to increase loading ratio at a high reproducibility.

In the present paper, results are shown for the preliminary loading experiments and the crystallographic analysis of Pd electrodes, and some considerations are made for the strategy to get high loading ratio.

Measurement of loading ratio during electrolysis was conducted in sealed cell containing 1M LiOD pressurized by deuterium gas in which a gas diffusion electrode was employed as an anode. Palladium cathode materials obtained from IMRA MATERIALS, Tanaka Kikinzoku,and Johonson Matthey were used for the experiments.

We compared the experimental results for the loading ratio in which

- worked material, high purity material, single crystallized palladium
- annealing, etching
- Pd-Au, Pd-Rh, Pd-Cu alloys

were used as cathodes.

JAPAN - NEW HYDROGEN ENERGY PROJECT

Naoto Asami, Kazuaki Matsui (R & D Ctr. for New Hydrogen Energy, Sapporo, and Inst. Appl. Energy), and Fumihiko Hasegawa (New Energy and Indust. Tech. Dev. Org.), "Present Status and the Perspective of New Hydrogen Energy Project," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #210.

AUTHORS' ABSTRACT

A research and development project with respect to the excess heat generation during electrolysis with Pd-LiOD, which was named "New Hydrogen Energy," was started in November 1993 in Japan. The Ministry of International Trade and Industry and major industries in Japan have been supporting the project in a new laboratory which has been established in Sapporo. The present status and the perspectives of the project will be reported together with several technical papers.

1. Demonstration of excess heat generation:
Two types of electrolysis cells, namely the open type cells from IMRA-Europe Inc. and the fuel cell type cells from IMRA-Japan Inc. were installed in the NHE Sapporo Laboratory and the experiments have been started from February 1994 to demonstrate the phenomena. Data analysis and evaluation methods for open type cell experiments have been established to minimize the data processing errors. Palladium electrodes from various sources and treatments have been examined mainly to identify the effects on deuterium loading using the fuel cell type cells.

2. Material analysis and development:
Correlations among the attainable D/Pd ratio, deuterium absorption and desorption rate and the characteristics of palladium have been investigated based on material analysis by O/M, SEM, XRD, AES, and SIMS.

These activities will be reinforced by flow calorimetry as well as detection of reaction products; an interim peer review is scheduled for late 1995.

JAPAN - MATERIALS & SURFACE IN LOADING

J. Minato, T. Nakata, S. Denzumi, Y. Yamamoto, H. Aida, M. Kobayashi, N. Miki and K. Kunimatsu (IMRA JAPAN CO. LTD., Sapporo), "Materials/Surface Aspects of Hydrogen/Deuterium Loading into Pd Cathode," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, # 501.

AUTHORS' ABSTRACT

Among the various factors controlling the cathode loading by hydrogen and deuterium influence of ordinary electrolysis conditions such as acid/base property of the electrolyte which determines the mechanism of hydrogen evolution at the cathode, current density, overvoltage, temperature, isotope effect and cation effect have been systematically investigated and are understood fairly well. The effect of a catalytic poison such as thiourea has been investigated below 0.6 mM and improvement of cathode loading has been confirmed, and even higher improvement is anticipated at higher thiourea concentrations.

Influence of bulk and surface property of the Pd cathode on the cathode loading has been investigated to much less satisfactory extent. Our recent studies on the effect of the surface modification by thiourea up to 1M solutions have revealed remarkable improvement in the cathode loading even in D_2SO_4 in which cathode loading is usually very poor. It has been shown also that purity and grain size of the Pd cathode have little effect on the cathode loading, and **these new results suggest that the most important factor to control the cathode loading is its surface property provided that other factors including electrolysis geometry are optimized**. Effect of deload-load cycles on cathode loading reported by Will et al. has been confirmed in the present study although it is not yet clear if it is associated with modification of the bulk or surface property.

JAPAN - OBTAINING HIGHER LOADING RATIOS

Hikaru Okamoto, Toshiyuki Sano, Yosuke Oyabe, Toshihisa Terazawa and Tamio Oi (IMRA Material R&D Co., Ltd., Aichi), "Approach to Obtain Higher Deuterium Loading Ratio of Pd Cathodes," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, # 505.

AUTHORS' ABSTRACT

Efforts were made to achieve a high loading ratio, D/Pd, by the electrolysis of a 1M $LiOD/D_2O$ solution. It has been believed or recognized that the high loading condition, D/Pd=1, must be at least satisfied to generate heat excess reproducibly. The deuterium loading ratios were measured by electric resistance method. From the changes of resistance (R/R_O), we can estimate the loading ratios.

Prior to the experiments of the loading ratio, we have decided a standard process to make the Pd electrodes and a standard electrolysis condition. Many kinds of Pd cathodes were prepared and their loading ratios were determined following

this standard electrolysis condition. Some of Pd cathodes were added some treatments to change the surface condition. As the results, we have found that Pd surface condition was very sensitive to the loading ratio. For example, loading behavior of a Pd sample of which surface was modified. Compared with the loading behavior of the standard processing Pd, higher loading ratio (D/Pd ≈ 0.95) was obtained at 200 mA/cm^2. The details will be discussed later.

JAPAN - NUCLEAR PRODUCTS IN VACUUM CONDITIONS

Takehiko Itoh, Yasuhiro Iwamura, Nobuaki Gotoh and Ichiro Toyoda (Adv. Tech. Res. Ctr., Mitsubishi Heavy Indust., Ltd, Yokohama), "Observation of Nuclear Products under Vacuum Conditions from Deuterated Palladium with High Loading Ratio," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #311.

AUTHORS' ABSTRACT

Gas release experiments in a vacuum chamber have been performed with a method of heating highly deuterated palladium metals (D/Pd = 0.8) to induce anomalous nuclear effects. We previously reported that neutron emissions and tritium production were observed even with low deuterated palladium metals (D/Pd = 0.66). It is expected that the yield of nuclear products will increase using highly deuterated palladium metals (D/Pd = 0.8), since it has been widely recognized that anomalous nuclear effects are related to the D/Pd ratio.

Deuterated palladium samples with high loading ratio were prepared as follows. Palladium rods (ϕ3 x 25 mm) were set in a D_2O-LiOD electrolysis cell. The cell was operated in constant current for 24 hours, and the loading ratio reached about D/Pd = 0.8. We electroplated the samples with Cu in $CuSO_4$ electrolysis to reduce the rate of deuterium gas release and to maintain high deuterium loading ratio. The sample was introduced into the vacuum chamber and set on a heater. The chamber was equipped with two He-3 neutron detectors, a CdTe X-ray detector, two silicon surface barrier detectors (SSB) for charged particle spectroscopy and a high-resolution quadrupole mass analyzer for released gas analysis.

Neutron emissions and tritium production were detected during deuterium release from the palladium metal by heating the sample up to 400K. In addition, X-ray emissions were observed in some cases. The rate of formation of nuclear products from highly deuterated palladium metals was considerably higher than that from the samples with low deuterium loading ratio (D/Pd = 0.66). Recently we have introduced an ionization chamber for quantitative tritium analysis. Experimental results of tritium production from the samples will be reported together with results of other nuclear measurements. Further, various conditions for increasing the yield of nuclear products, such as D/Pd ratio, deuterium loading methods and pretreatment of samples will be discussed.

JAPAN - HEAT FROM D IMPLANTED Al

K. Kamada (Nat. Inst. Fus. Sci., Nagoya), H. Kinoshita and H. Takahashi (Dept. Engr., Hokkaido Univ., Sapporo), "Anomalous Heat Evolution of Deuteron Implanted Al on Electron Bombardment," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #203.

AUTHORS' ABSTRACT

Anomalous heat evolution, which continues for about 2 x 10^{-11} seconds, was observed in deuteron implanted Al foils on 175 keV electron bombardment. Local regions with linear dimension of more than 100nm each showed simultaneous transformation from single crystalline to polycrystalline structure in roughly one minute on electron bombardment, indicating a temperature rise from room temperature to beyond the melting point of Al. The amount of energy evolved was typically 160 MeV for each transformed region. The transformation was never observed in proton implanted Al foils. The heat evolution was presumed to be a result of some kind of nuclear reaction in D_2 molecular collections.

JAPAN - PHOTOGRAPHS OF COLD FUSION

Takaaki Matsumoto (Dept. of Nuc. Eng., Hokkaido Univ. Sapporo), "Artificial Ball-Lightning --Photographs of Cold Fusion," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco.

AUTHOR'S ABSTRACT

Ball-Lightning is a natural phenomenon, in which many extraordinary behaviors have been reported [1-3]. For example, ball-lightning entered a house through a stack and went out again or exploded. The properties of ball-lightning have not yet been made clear.

During some kind of cold fusion experiments, artificial tiny ball-lightning frequently appears on the surface of electrodes. The tiny ball-lightning can easily be produced by electrical discharges in water. Photo 1 shows the artificial tiny ball-lightning, which was generated by the pinch effect of the electrical current. Here the cathode of Cd wire (0.5mm ϕ) was immersed in ordinary water mixed with about 1.5 Mol/1 potassium carbonate. The DC current was charged and the microsparks appeared over about 40 V. The ball-lightning is a highly compressed cluster of hydrogen atoms ("itonic" state). On the anode, on the other hand, a bank of clouds appeared with weak luminescence, as shown in Photo 2.

The artificial ball-lightning sometimes has the ring structure, as shown in Photo 3. It was negatively charged and magnetized. In the ring zone, the nuclear transmutation took place. The ball-lightning can easily penetrate through layers of glass, acrylite or water, despite with those large dimension and heavy charges, and finally decays to a hexagonal plate, as shown in Photo 4. Furthermore, it can jump up and down, against the gravity of the earth. Photo 5 shows ring traces left on nuclear emulsions, in which the pulsed AC shots were employed between wire electrodes.

Photo 6 also shows the ring products during the AC shots, which were arranged through the dislocation line of the electrode of a Cu single crystal. The Nattoh Model predicts that the formation of the "itonic" state of the hydrogen cluster during the cold fusion process. Photo 7 shows the break-up of the itonic hydrogen cluster, which was produced during the AC shots.

Furthermore, extraordinary traces were found during the discharge experiments, which suggests the production of the prototype of microbacteria, as shown in Photo 8.

JAPAN - NEW HYDROGEN ENERGY RESEARCH

M. Okamoto (Res. Lab. for Nucl. Reactors, Tokyo Inst. Tech., Tokyo), K. Matsui (Inst. Appl. Energy, Tokyo), and F. Hasegawa (New Energy & Indust. Tech. Dev. Org., Tokyo), "The Present Status and Scope of the Japan Basic Research Project of New Hydrogen Energy," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #211.

AUTHORS' ABSTRACT

The Japan Basic Research Project of New Hydrogen Energy (NHE) has been conducted since December 1993 and will be performed until 1996, financially supported by 20 Japanese Industries. The object of the project is to back up the NHE national project of MITI with a strong scientific basis.

In the research project, 11 research groups from 9 universities have carried out their basic researches in the following fields:

(1) Calorimetry for absolute evaluation of the excess heat;
(2) Correlations of the excess heat and the nuclear effects;
(3) Nuclear physical bases;
(4) Materials for the NHE process.

There have been significant outputs from the research project even in the past fifteen months since the start, and many of the outputs will be presented in the present ICCF-5. As one of the aspects of the research project, we have developed national and international collaborations, researcher and information exchanges as well as scientific meetings including international workshops.

In the presentation we will report the present status and scope of the research project together with a summary of the research outputs and future program.

JAPAN - NUCLEAR PRODUCTS CORRELATION

A. Takahashi, H. Miyamaru, T. Inokuchi, Y. Chimi, T. Ikegawa, N. Kaji, Y. Nitta, K. Kobayashi and M. Taniguchi (Dept. Nucl. Engr., Osaka Univ.), "Experimental Correlation Between Excess Heat and Nuclear Products," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #207.

AUTHORS' ABSTRACT

A twin system of electrolysis, calorimetry, neutron spectroscopy and X-ray spectroscopy has been developed for open-cell type CF experiments. It consists of two nearly identical set-ups consisting of an outer neutron shield of polyethylene, the electrolysis cell, a NE213 neutron detector and Cd-Te X-ray detector with PC-based data acquisition system. One heavy-water electrolysis cell with Pd-sheet cathode serves for the "foreground run", and the other heavy-water electrolysis cell with Ni-sheet cathode serves for the "background run." Electrolysis current and coolant water condition are always the same for the two cells because of series connections of flows. When we observe anomalous phenomena (excess heat, neutron and X-ray generation) only for the Pd-cell, for example, the results must be very reliable due to the twin conditions.

Results of a series of experiments using cold-worked (or annealed) Pd plate cathodes and low-high mode electrolyses with various patterns will be presented. An experiment with cold-worked Pd plate showed small but very clear excess heat generation (5.6 w/cc; about 6% excess) for about 200 hr, while the background cell with Ni-plate showed just 0.0 watt excess within 1.0 watt error bar. The variation of the D/Pd ratio under the excess heat generation was estimated, by in-situ measurement of D/Pd vs. current density in a separate closed cell system, to be D/Pd = 0.9 (in L-mode) and about 0.8 (in H-mode). Neutron spectroscopy was done by a two-dimensional pulse-height vs. pulse shape separation technique. A slight (20-30% above background level) increase of total neutron counts was often observed in several weeks starting after about one week of L/H mode operation. In the energy region larger than about 3 MeV, a characteristic structure of the neutron spectra was observed, corresponding to the increase of the total count rates. However, the neutron emission rate was about 2 n/s at most and appeared to decrease when the excess heat rates increased, as was the case for our 1992 experiments.

Significant burst events (20-100 counts/min) with Cd-Te detectors for X-ray detection were frequently observed from the Ni-cell and sometimes from the Pd cell. Especially, four

successive burst events (spreading in 20-30 minute duration) were observed from the Pd-cell, being coincident with four successive ON-to-OFF changes of electrolysis. These burst events showed always similar broad-peaked spectra in 10-30 keV of X-ray energy scale. Identification of these anomalous signals from Cd-Te detectors is under way.

NETHERLANDS - VARIATIONS IN RADIOACTIVITY

Otto Reifenschweiler (Philips Res. Labs., Eindhoven), "Some Experiments on the Variation of the Radioactivity of Tritium Absorbed by Titanium," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #305.

AUTHOR'S ABSTRACT

Small amounts of tritium are absorbed by titanium preparations consisting of small monocrystalline particles ($\phi \cong 15$ nm) obtained by gas evaporation. In a first experiment, a $TiT_{0.0035}$-preparation is heated and the radioactivity, A, is measured via the X-radiation detected by a GM-tube. The radioactivity decreased from the initial value down to 72% at 160°C, further decreased to 60% at 275°C and increased again to the initial value at 360°C before decomposition of the preparation. It is shown that, during the whole temperature trajectory up to 360°C, no loss of tritium has occurred and that the decrease of the count rate is entirely due to the decrease of tritium radioactivity.

A detailed analysis of the generation of the X-radiation shows that it is not possible to explain the course of A = f(t) by changes from chemi-absorption at the surface to bulk absorption of the tritium in the small Ti-particles as has been claimed recently. In a second important heating experiment with a $TiT_{0.035}$-preparation, the tritium is desorbed during heating on account of the 10 times higher concentration and the tritium released from the preparation is measured by a second GM-tube. By addition of the two radioactivities, that remaining in the solid and that expelled as a gas, it is shown that the course of A = f(t) is equivalent for both experiments carried out under very different conditions. In a further heating experiment with a $TiT_{0.065}$-preparation where the surface of the Ti-particles is oxidized, a course of A = f(t) of the same kind as that for the first experiment is obtained. The evaluation of these three heating experiments done under very different conditions gives a high degree of evidence for the decrease of tritium radioactivity.

A first attempt is presented to explain this remarkable effect in terms of a nuclear pair hypothesis.

There is strong suspicion that the two different effects, cold DD-fusion and the decrease of tritium radioactivity, are caused by the same or by two related fundamental principles. A cold DD-fusion experiment is proposed.

RUSSIA - HIGH ENERGY & GLOW DISCHARGE

A.B. Karabut, S.A. Kolomeychenko and I.B. Savvatimova (Scientific Industrial Association "Luch", Moscow Region, Russian Federation), "High Energy Phenomena in Glow Discharge Experiments," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, # 327.

AUTHORS' ABSTRACT

The results of gamma and fast electron registration in glow discharge experiments are reported. Cathodes were made of Pd, Nb and other materials. Hydrogen, deuterium and argon were used. The typical gas pressure was 3-7 Torr, the discharge current 5-100 mA. The gamma spectra standing out above the background were registered using a Ge-Li detector. In the range from 60 to 1,000 keV, the gamma signal exceeds background by 10^3 - 10^4 s^{-1}.

The monoenergetic bunches of penetrating radiation (presumably fast electrons) were registered using X-ray films with step attenuators and multiplying screens. The bunches are characterized by low angular spread (2-3 x 10^{-3} radian) and by short duration. The energy of the bunches and their other characteristics depend on the properties of the cathode material and the discharge gas.

Generation of high voltage pulses (up to 10^5 V) of short duration (40-60 ns) was registered by electric probe measurements. The pulse spectra represent patterns with the pronounced lines specific to the cathode material and discharge gas. Based on these results and the data on the isotopic and elemental change in the cathode material, possible mechanisms for the initiation of nuclear reactions are discussed.

RUSSIA - BRONZE CRYSTALS & NEUTRONS

S.V. Vakarin, A.L. Samgin, V.S. Andreyev and S.A. Tsvetkov (Inst. of High Temp. Electrochemistry, Ural Branch of Russian Academy of Science), "Influence of Mono-Crystalline Perfection of the Oxide Sodium Tungsten Bronze on Neutron Emission," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #321.

AUTHORS' ABSTRACT

There are known works where oxide tungsten bronzes are sources of neutron emission in experiments of cold fusion. Recently, a number of research groups have tried to replicate these experiments. However, there has been no satisfactory repeatability. Our experiments allow us to determine the relation between crystalline lattice perfection and neutron

emission, which makes it possible to establish criteria for the crystal selection on the basis of X-ray structural analysis.

At the present time, it has been verified that positive results were achieved with the crystal specimens having a "character" radiogram of the "working" edge. These crystals have a perfect structure as confirmed by X-ray topograms. However, during experimental runs the perfection of the crystal diminishes, followed by sharp decline of neutron emissions. This assumption is well supported by X-ray analysis and topography. It is notable that crystals which had the same structural defects did not show any neutron emission. These results led to the conclusion that a necessary requirement for positive cold fusion effects with tungsten bronzes is a high level of perfection of the surface layer of the mono-crystal's working edge. Also, there is a possibility that neutron emission occurred during transformation of the crystalline lattice, which is a modification of the cold fusion "accelerating" model.

RUSSIA - COLD FUSION IN KD_2PO_4 CRYSTALS

V.A. Kuznetsov, A.G. Lipson, E.I. Saunin (Inst. of Phys. Chem. of the Rus. Acad. Sci., Moscow), "Anomalous Heat Effects and Cold Fusion in KD_2PO_4 Crystals upon the Ferroelectric Phase Transition," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, # 611.

AUTHORS' ABSTRACT

By the application of differential scanning calorimetry technique the quantitive variations of ferroelectric phase transition heat (ΔH) in both KD_2PO_4 and KH_2PO_4 single crystals have been studied. The rate of cooling and heating was varied from 0.5 K/min to 4.8 K/min. It was established that at the large number of thermocycles ($n \geq 20$) the quantity of ΔH for KD_2PO_4 crystal undergoes the inversion of value, such that ΔH_{exo} begins to excess ΔH_{endo}. The same anomaly in ΔH behavior is not observed for KH_2PO_4 crystals, for which at any number of thermocycles: $\Delta H_{exo} > \Delta H_{endo}$. On the basis of data obtained the conclusion have been made about the opportunity of contribution of KD_2PO_4 crystal domain walls elastic energy in total ferroelectric phase transition heat. The absence of the same heat evolution mechanism was established for KH_2PO_4 crystals. The quantitive model of anomalous heat effects in KD_2PO_4 crystals is proposed. This model is based on the hypothesis of domain walls elastic energy concentration in separate domains of KD_2PO_4 crystals.

The evolution of domain walls elastic energy for KD_2PO_4 crystal is and its absence for KH_2PO_4 can be referenced to the next model. Upon the fusion of deuterons interacted with superlarge fluctuations of elastic energy density of domain walls, i.e. with coherent multyphonon excitations the process of addition of virtual neutrons to ^{39}K nucleus can take place with evolution of neutron bond energy in ^{40}K to the lattice.

RUSSIA - NEUTRON FLUX TRANSMITION

A.G. Lipson and D.M. Sakov (Inst. of Physical Chem. of the Russian Academy of Sciences, Moscow, Russia), "Amplification of the Neutron Flux Transmitted Through KD_2PO_4 Single Crystal at the Ferroelectric Phase Transition State," ICCF-5, Monte-Carlo, Monaco, Book of Abstracts, #320.

AUTHORS' ABSTRACT

The phenomenon of the amplification of an external neutron flux (about 10% of the total value) by transmission through a KD_2PO_4 (DKDP) single crystal at the ferroelectric phase transition has been established. The external flux from a Cf^{252} neutron source ($I = 3 \times 10^2 ns^{-1}$ in 4π) was partially moderated by polyethylene (Co). No such amplification of the neutron flux was observed if the DKDP crystal was outside the phase transition temperature interval. The variation of the excess neutron emission intensity ejected by DKDP crystal at the different detector background levels has been studied. The intensity of neutron emission (after subtraction of the background) is increased from 0.01 count/s at cosmic background level (0.01 count/s) to 0.20 count/s at 1.1 count/s background level of the detector (with Cf^{252}). The dependence of counts rate of neutron events on the efficiency in DKDP crystal-detector system has also been investigated. The correlation between the value of the external neutron flux transmitted through the DKDP crystal and intensity of excess neutron emission from this crystal was determined. The non-isotropic distribution of excess neutron emission from DKDP crystals has been established. The data obtained for DKDP crystals irradiated by an external neutron flux at the ferroelectric phase transition could be the confirmation for an hypothesis: "cold fusion" neutron emission is induced by external irradiation of cold fusion objects by the cosmic background neutrons.

RUSSIA - THERMAL EFFECTS IN $LiD/D_2(Pd)$

V.A. Khokhlov, E.S. Filatov, A.L. Samgin, O.V. Finodeyev*, V.S. Andreyev, S.A. Tsvetkov (Inst. High Temp. Electrochem., Ural Branch Rus. Acad. Sci., Ekaterinburg, and *ENECO Inc., Salt Lake City, Utah), "`Anomalous' Thermal Effects in the $D_2(Pd)$ Loaded Electrode in Molten Alkali Chloride-Alkali Deuteride Electrodes," ICCF-5, April 9-13, 1995, Monte-Carlo, Monaco, Book of Abstracts, #209.

AUTHORS' ABSTRACT

The thermo-electrochemical study of

$$Li(Al)/(LiCl\text{-}KCl)_{eut} + LiD/D_2(Pd) \quad (1)$$
$$Li(Al)/(Li\text{-}KCl)_{eut} + LiH/H_2(Pd) \quad (2)$$

cells was carried out by means of reliable experimental apparatus for calorimetric measurements.

In electrochemical cells (1) with a sharp change of current density on the Pd-anode from 4 to 290 or 420 mA/cm^2, stable "excess" heat effects were observed that could not be explained by isotopic differences in electrochemical reactions while these effects were not found in the similar cell (2) containing lithium hydride. In under-saturated solutions of lithium deuteride in the molten eutectic of LiCl-KCl, the thermal effects mentioned are apparently diminished because of a decreasing concentration of deuterium in the Pd.

RUSSIA - HYDROGEN SUPERFLUIDITY

A. Krivoshein, D. Mamaev ("TNP," Obninsk, Kaluga region), "Atomic Hydrogen in Liquid Helium," presented at the 5th International Conference on Cold Fusion, Monaco, 9-13 April 1995, 4 mss pages, 2 figs, 13 refs.

AUTHORS' ABSTRACT

Discussion of opportunity of hydrogen superfluidity detection and proton superconductivity in binary systems. The plan of the prospective experiment and it's results are described.

YUGOSLAVIA - NEUTRON DETECTION

A.J. Zaric, D.M. Sevic, R.D. Antanasijevic, Z. Maric (Inst. of Phys., Belgrade, Yugoslavia), S.V. Ribnikar (Faculty of Phys. Chem., Univ. of Belgrade), J-P. Vigier (Lab de Physique Theorique, France), "Neutron Detection in Plasma Focus and "Capillary Fusion" Experiments," ICCF-5, Monte-Carlo, Monaco, April 9-13, 1995, Book of Abstracts, #606.

AUTHORS' ABSTRACT

Experiments were performed which require high detection efficiency of a neutron detector. The experiments include total neutron yield measurements from plasma focus and "capillary fusion" devices. Results show that the large volume liquid scintillator neutron detector (NE 343) satisfies all demands concerning total neutron yield measurements.

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