FUSION facts

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CONTENTS FOR JULY 1991

MESSAGE FROM ROMANIA

Dr. Peter GLÜCK of Romania presented the following poster:

1. From 317 papers reviewed on cold fusion only 56 present positive results.
Conclusion: Cold fusion is statistically dead.

2. The Romanian dictator Nicolae Ceausescu was executed. The firing squad was scared. Had used 302 bullets but only 43 had hit deadly.
Conclusion: Nicolae Ceausescu is statistically alive.

THIS ISSUE PROVIDES A FULL REPORT ON THE SECOND ANNUAL COLD FUSION CONFERENCE HELD IN COMO, ITALY.

Coming in August: PdAg alloy in fusion cells!

A. NCFI FINAL REPORT ISSUED.

EVIDENCE STRONG FOR NUCLEAR BYPRODUCTS IN FUSION TESTS SAYS NCFI'S FINAL REPORT.

NCFI provided three volumes of its four-volume final report to the Utah state advisory council on Monday, July 15, 1991, after closing its doors due to lack of financial support. Volume IV of the final report is the Pons and Fleischmann report which was received but not as yet published.

Dr. Haven Bergeson, acting for the director of the NCFI, gave a summary of the final reports. He was cautious in his assessment of the research results but stated that developments were now conducive to the continuation of good low-key research efforts. Bergeson reported that at least 3 types of experiments will continue at the University of Utah: Fritz Will expects to continue work on surface chemistry; MacIntyre on materials science; and Bergeson, Barrowes, & West on physics of cold fusion. As a tenured professor in the Physics Department at the University of Utah, Bergeson was asked to resign from all faculty committees when he accepted the job of assistant director to the NCFI. We commend Bergeson on his integrity of pursuing science in the face of controversy.

Dr. Wilford Hansen, a council member, reported on his lengthy assessment of Pons and Fleischmann data. In his careful report, Dr. Hansen related his findings to the committee that the excess heat, in one of Pons-Fleischmann experiment, amounted to over 2,000 eV per palladium atom. Five eV per Pd atom is sufficient to vaporize palladium.

Dr. Hansen also reported that an even more energetic Pons & Fleischmann experiment resulted in a total excess energy of 6,000 eV per Pd atom.

The multi-volume final report from the NCFI is available from the National Technical Information Service. See Section F for details.

The August issue of *Fusion Facts* will cover the **Final Report** of the NCFI in more detail.

B. REPORT ON ACCF2, COMO, ITALY

CONFERENCE HIGHLIGHTS

Drs. Pons and Fleischmann attended the conference and reported that they are having good results with the palladium/silver alloy they are now using for cathodes.

Robert T. Bush's model predicts neutrons in the temperature region of -120C reported by Dr. Franco Scaramuzzi in his recent experiments. This model prediction of an experimental result is something of an historical first.

An excellent survey of five year's of fracto-fusion to current cold fusion work in the USSR was presented by Tsarev of Russia. The survey covers early work wherein only a few neutrons are detected to current efforts where millions of neutrons and measurements of excess heat up to 150% have been reported.

An excellent survey of hydrogen in metals was given by L. Schlapbach, editor of Hydrogen in Intermetallic Compounds, Springer-Verlag, c1988.

Claytor's (LANL) work in producing tritium using Pd-Si under high deuterium gas pressure.

Fritz Will's report on "tritium produced every time" in the last work at NCFI.

McKubre's work at SRI, International sponsored by EPRI in which as much as 250% excess heat was reported but not detailed.

The thin-film palladium (over silver) results by Eagleton and Bush where they have achieved up to 30% excess heat and, more impressive, up to 3 Kw/cu cm of Pd has been achieved.

Perhaps the most promising: A fax from B.F. Bush (Naval Weapons Center, China Lake, CA) to M.H. Miles at the conference stating that their latest cell had produced excess heat in less than one day by using a cathode plated with palladium black. Szpak (NOSC) is also suggesting high repeatability with plated Palladium.

The lack of negative comments. Dr. Douglas R.O. Morrison was kind enough not to attempt to correct all of the positive reports. A big sign that the "hot-fusion conspiracy" is running out of steam. [See also Letters to the Editor for more about Dr. Morrison.]

ROUND TABLE - SIMILARITIES & DIFFERENCES IN COLD FUSION EXPERIMENTS.

Chaired by Dr. D. Worledge (EPRI)

Round Table members were Stanley Pons, M. Ikegami, M.H. Miles, Xing Zhong Li, and B.Y. Liaw.

At the First Annual Cold Fusion Conference, Dr. Worledge summed up his evaluation of the progress of cold fusion by being skeptical, especially of excess heat. After two years of EPRI funding and some dramatic developments by EPRI-funded scientists, Worledge gave essentially the same year-old summary except on this presentation he played games by intimating that he wasn't stating that this is what he really thought. This approach did nothing to endear him to the audience. However, members of the round table contributed the following important observations:

Pons emphasized that no **known** chemical processes explain the excess heat that has been reported by many competent scientists. Pons and Fleischmann are having "good success" with palladium-silver alloy but they are not ready to publish the data as yet.

Ikegami (Japan) stated the importance of determining whether the excess heat effects are bulk or surface effects. He suggests that data should be reported in terms of volume to surface ratio. The deuterium/metal ratio tends to saturate first near the surface. We need to measure and report the precise values of deuterium to metal ratios.

Miles (China Lake) states that seven out of ten cells gave excess heat. Maximum is about thirty percent excess heat. In their experiments they thought they would measure helium-3 (as Schwinger predicted) but were surprised to find no helium-3 but helium-4.

Li summarized that, so far, palladium gives better results than titanium. The branching ratios are about neutrons = 1; then tritium is about 10^9; and excess heat would require about 10^{13} d-d nuclear events to explain the amount of heat being reported. More helium-4 measurements are needed and more workers are needed to clearly define the physics of cold fusion.

Liaw asked why all papers on hydrogen experiments are accepted but that similar papers on deuterium results were challenged so harshly.

R.T. Bush emphasized the importance of the Bush-Miles finding (China Lake) that a palladium cathode blackened with palladium black was reported to achieve excess heat within about two hours.

Bockris indicated that Worledge's stance on being more prone to believe the neutron evidence more than the tritium or excess heat evidence should be revised. All over the world scientists are finding a very small ratio of neutron to tritium; similarly many scientists are reporting megaJoules and even gigaJoules per mole of palladium

in terms of excess heat. The evidence is that the data for both tritium and excess heat production is just as compelling as the evidence for neutron production.

Fleischmann pointed out that chemists are, in general, more experienced in working with thermodynamics than are physicists. He also suggested that we cannot uninvent an explanation or a new science.

Preparata suggested that Worledge is a difficult person to convince [or that he is playing games. Ed.] Scientists are working under extremely difficult conditions but are nearly all getting positive results [in their cold fusion experiments.]

Pons showed a couple of data graphs and stated that they are getting about 100% reproducibility using the palladium/silver alloy for cold fusion cathode.

McKubre stated that the problem was not reproducing an experiment but reproducing the initial conditions.

Tsarev stated that we have been presented with some questions by Nature. We must answer these questions.

Worledge suggested that using a plasma focus approach to test an array of materials would be a useful materials screening technique.

GLEANINGS FROM THE FINAL ROUND TABLE

The final presentation of the conference was a Round Table chaired by Dr. Martin Fleischmann, "Cold Fusion 1991: where do we stand, where do we go?"
Members of the Round Table: Guiliano Preparata, McKubre, F. Will, R. Huggins, & V.A. Tsarev.

M. Fleischmann set the tone of the discussion by listing eight topics to be considered:

DEVELOPMENT
1. Products of nuclear reaction.
2. Heat as a product of nuclear reaction.
3. Coupling theory and experiment.

NEW APPROACHES
4. Electrochemistry, surface science, solution chemistry.
5. Materials science.
6. Imaging: autoradiography etc.
7. New Experiments.
8. Adequate Reporting.

Tsarev noted that we need a new generation of apparatus and experiments. Multi-parameter analysis is needed. We are approaching the answers to the questions that we must ask of Nature. Wide collaboration is needed.

F. Will noted that tritium is now produced reliably and that one can measure as little as 10^7 atoms of T. Would like to see an on-line technique for the continuous monitoring of tritium.

M. Fleischmann emphasized the need for mass spectrometer that can specifically measure ^{4}He [in the presence of similar masses.] He also emphasized that **heat is the major nuclear signature** of cold fusion.

Other comments: Large electrodes crack and allow the deuterium to escape. Silver seems to stabilize the Pd against cracking. A great need for a replicable experiment to warrant further studies. Plating the cathode with palladium black may be the answer to replication. B.F. Bush (China Lake) and Szpak (NOSC) both stating that plating (or platinizing) the cathode, such as with PdCl in a plating solution, is the answer to accelerated loading.

EDITOR'S OBSERVATION: Few groups are working with both theory and experiments. An exception is the team of R.T. Bush and R.D. Eagleton. This team has had excellent results in the co-development of experimental work and the Transmission Resonance Model. Their thin-film (Pd onto Ag) cathodes have produced a remarkable amount of energy per cubic centimeter of Pd.

CONFERENCE PAPER ABSTRACTS WITH ATTENDING EDITOR'S COMMENTS
By Hal Fox

EXPERIMENTAL, ELECTROCHEMICAL LOADING (29 Abstracts submitted)

ITALY - 17% EXCESS HEAT

L. Bertalot, L. Bettanali, F. De Marco, V. Violante (ENEA, Dipartimento Fusione, Centro Ricerche Energia Frascati, Rome, Italy), P. Delogu, T. Di Kominas Makris, A. La Barbera (ENEA, Dipartimento Inn-PCM Rome, Italy), "Results of Heavy Water Electrolysis with Pd Cathodes", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

A series of electrochemical cells was set up mainly with the objective of tritium detection. In the framework of a collaboration with the Texas A&M University also some calorimetric measurement were carried out. In the experiments aimed to tritium analysis particular care was given to a clear assembling of the cells and to avoid possible tritium contamination. Nine cells were installed with different materials and geometry. No tritium in

excess of the isotopic enrichment was detected. Post mortem surface analysis shows contamination of the Pd surface. In the calorimetric experiments, one cell out of three gave about 17% of excess heat for ten days, corresponding to 55 kJ.

ITALY - NEUTRONS FROM Ti

A. Bertin, M. Bruschi, D.Vulgarelli, V.M.Bystritsky, M.Capponi, I.D'Atone, S.De Castro, D. Galli, U. Marconi, I. Massa, C. Moroni, M. Piccinini, M. Poli, N. Semprini-Cesari, M. Villa, A. Vitale, G. Zavattini and A. Zoccoli (Dipartimento di Fiscia, Universita di Bologna, & Instituto Nazionale di Fisica Nucleare, Sezione di Bologna, Italy), "Search for Neutron Emission Following Electroinfusion of Deuterons into Titanium Samples in the Gran Sasso Laboratory" Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

Following our early results [1], a novel dedicated apparatus has been put in operation at the Gran Sasso Laboratory to look for neutron radiation emitted following the electrolytic infusion of deuterons into metal cathodes. The renewed setup provides additional shielding of the natural gamma radiation, two independent acquisition systems, and the possibility of looking for neutrons and gammas by different detectors. In particular, it includes a novel coincidence neutron spectrometer [2], allowing neutron identification by means of two independent stages of pulse-shape analysis. Extended background measurements have shown that the signal-to-noise ratio (referring to the neutron counting rate observed in the past [1]) is improved by a factor of 400 [3]. The apparatus is presently being used with titanium cathodes in D_2O cells to look for the emission of 2.5 MeV neutrons. The results of measurements underway will be presented and discussed.

References:

[1]. A. Bertin, et al., *Il Nuovo Cimento*, **101A**, 997, (1989); *J. Fusion Energy*, **9**, 209(1990); and *Proc. Int. Symp. on Muon Cat. Fusion*, ??? mu Cf-89, RAL-90-022, 114,(1990).

[2]. A. Bertin, et al., "A Novel Neutron Spectrometer with Neutron-Gamma Pulse-Shape Discrimination, to be published in *Muon Catalyzed Fusion*.

[3]. S. Affatato, et al., *Il Nuovo Cimento* , **104A**, 437(1991); and in *Proc. of Int. Progr. Rev. on Anomalous Nuclear Effects in Deuterium/Solid Systems*, BYU, October 22-23, 1990.

EDITOR'S COMMENTS

During spring of 1991, the background measurements were 1.5 +/- 0.5 x 10^{-5} neutrons per sec. Efficiency measurements were about 2-3%. Over a period of 18 hours, 486 events (with coincidence) were counted.

TEXAS - FUGACITY & EXCESS HEAT

J.O'M. Bockris, Z. Minevski, and D. Hodko (Texas A&M Univ.), "The mechanism of D_2 evolution on Pd and its relevance to cold fusion", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHOR'S ABSTRACT

In recent times much attention has been given to interpretations of the so-called fusion reactions which were related to the concept of high fugacity within the metal depending on the overpotential applied. In the present paper some preliminary electrochemical investigations of mechanisms of D_2 evolution on Pd are outlined together with a report on some recent research upon the effect of electrical pulsing upon the initiation of excess heat generation. Cathodic overpotentials and overpotential decay transients for PdD_2 electrode were measured in KOD and LiOD solutions. The mechanism of the deuterium electrode reaction is investigated and two Tafel slopes are obtained. In order to characterize the Pd surface and to find out the influence of different species, present on/in Pd, on the mechanism of D.E.R. surface techniques XPS and EDS were employed. Surface spectra and depth profiling up to 200 A are analyzed for samples exposed to different pretreatment such as annealing/abrading or exposed/not exposed to electrolyzing conditions. The atomic concentration of ad/absorbed species (Zn, Pt, Au, Cu, Fe, etc.) changes with the pretreatment and electrolysis. In respect to above impurities, the presence of Si is much less pronounced. Neutron activation analysis was employed to determine the presence of different species in solutions before and after the electrolysis. Following species are found at detectable levels: Pt, Au, and Na. Light water concentration measured by NMR technique is found to be less than 1%.

Enthalpy generation during long term electrolysis of Pd in O.1 M LiOD is measured by a calorimetric method. Four-probe resistivity measurements were used to optimize a current-charging regime and to monitor changes in D/Pd ratio. Increase in current occasionally caused enhancement of D/Pd ratio (up to 0.8). After charging, the electrodes were pulsed in a potentiostatic mode. A typical pulsing regime consisted of cathodic (up to 1 A per sq cm) and anodic pulses of equal duration. The cell pulsed with 5 ms regime for more than 30 days showed no measurable excess heats. Applying 5s pulsing regime

excess heats of up to 23% were observed, Fig. 2. The application of 5s pulsing regimes caused electrode to slowly discharge. An interesting observation was that excess heat bursts appeared to be correlated with the process of charging of electrode and enhanced with repetitive pulsing. The total energy production in excess enthalpy bursts shown in Fig. 1 is approx. 39 MJ per mole, the amount exceeding known chemical origin.

EDITOR'S COMMENTS

Dr. Bockris gave an excellent discussion on fugacity and overpotential relationships. He noted that a relatively simple change in a device can cause large changes in fugacity. The change of 0.3 volts in overpotential can greatly increase the fugacity. During cracking of a Pd cathode, the deuteron loading can decrease. The surface condition of the cathode is important. Pre-electrolysis can be used in the pretreatment of the Pd cathode. Although replication is still a problem, excess heat has been measured that is far in excess of any known chemical process.

SPAIN - CATHODE SURFACE ANALYSIS

J. Brillas, J. Esteve and G. Sardin (Universitat de Barcelona), J. Casado, J.A. Sanchez-Cabeza & X. Domenech (Universitat Autonoma Barcelona), "Product Analysis from D_2O Electrolysis with Palladium and Titanium Cathodes", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

The enrichment of tritium in the electrolyte and the incorporation of species such as tritium, lithium and platinum to cathodes during the long-term electrolysis (15 to 30 days) of 0.1M LiOD solutions with Pd and Ti cathodes and Pt anodes in open cells, have been studied by means of different techniques (liquid scintillation counting, SIMS, ICP and mass spectrometry). The electrolyses have been carried out using initial solutions with different tritium activity (280 and 817 Bq ml^{-1}) and current densities ranging from 5 to 300 mA cm^{-2}. Blank electrolyses using Pt cathodes under the same experimental conditions have been also performed. Analysis of all electrolytes during D_2O electrolyses shows an **increase in their tritium activity** which can be explained considering values from the tritium-deuterium separation factor of all cathodes lower than 1. Accumulation of small amounts of tritium in the Pd bulk, proceeding from the absorption of the species pre-existing in the electrolyte, has been detected by electrolytic transfer of the accumulated tritium to a 0.1M LiOH solution, as well as by direct extraction of gases absorbed in the cathode, which were identified by mass spectrometry. Small quantities of lithium and platinum are also incorporated to Pd and Ti cathodes, which increase gradually by raising the current density. SIMS analysis of these cathodes allows to establish a preferential accumulation of lithium and hydrogen in their surface layers and confirms the absence of tritium into Ti cathodes.

EDITOR'S COMMENTS

This is the second group from Spain to be working on cold fusion (in addition to Univ of Madrid). The Spanish government has recently approved funding for cold fusion. This paper is important in showing that little tritium is expected to be found in the cathodes of either Pd or Ti.

CALIFORNIA - RECORD SET FOR HEAT/CM^3 OF Pd

Robert T. Bush and Robert D. Eagleton (Physics Dept, Calif. State Polytechnic Univ., Pomona, CA), "A Calorimetric Study of the Excess Heat Effect in Thin Films of Palladium", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

Cathodes consisting of thin films of palladium (5 microns to 60 microns) either electroplated or sputtered onto a silver substrate have been run in Fleischmann/Pons type electrolytic cells modified by employing a recombiner and a magnetic stirrer. There has been some initial success at Cal Poly in achieving the excess heat effect of Fleischmann and Pons in such thin films. Also, the results of additional experiments should be available for the conference.

EDITOR'S COMMENTS

Drs. Bush and Eagleton are noted for being one of the only teams that are working theory and experiments in tandem. Bush's TRM has explained several experimental results in cold fusion (including the prediction of neutron production at specific temperatures including one region reported at this conference by Scaramuzzi.) The unusual cathode structure, using a Pd-plated Ag cathode having a rectangular cross-section, has also produced an unusual amount of excess heat. After taking about three weeks to load (platinizing the cathode), the cell ran for 56 days and produced about 30% excess heat. Bush & Eagleton use a constant voltage source and noted that during the running time the current gradually dropped in value but that the cathode became "more efficient". They noted a long-term (several hours) cycle of changes in the amount of excess heat. Bush's model suggest that the "platinizing" of the cathode is essential to the onset of excess heat

production. Bush was delighted when Miles (of China Lake) reported a fax from B.F. Bush (China Lake) which reported a fast "turn-on" of a new cell by plating the Pd cathode with palladium black (PdCl used in the plating solution.) In addition, further evidence was presented, during this conference, as to the effectiveness of using Ag in the cathode (See Pons and Fleischmann, Chubb & Chubb, and Bucur).

Robert T. Bush and Robert D. Eagleton (Physics Dept., Calif. State Polytechnic Univ., Pomona, CA), "Neutron Emission from Electrolytic Cells: Correlation with Current Density", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

A study of neutron emission employing a group of twelve F/P type electrolytic cells linked in four subgroups of three cells each to test tubes containing recombiners has been made at Cal Poly. Tritium was also looked for in the recombined gases in the test tube and in the electrolyte of the cells. (However, the experiment was not set up to look for excess heat.) After about a month, two of the cells in one of the four three-cell subgroups exhibited a relatively high tritium assay compared to the cells of the other three subgroups. A successful attempt was then made to detect neutrons from this group of cells employing a BF_3 counter. Neutron counting rates were compared at relatively high and low densities for the three F/P type cells collectively. This and a separate study of neutron counting rate versus current density for the three collectively provide support for the author's theoretical model, the "transmission resonance model" (TRM). Results of an attempt to replicate these experiments at Cal Poly should be available for the conference.

EDITOR'S COMMENTS

There is no question that the TRM has made a mark by the prediction of neutron production as a function of temperature. Dr. Bush presented a many page computer printout derived from his model. The printout showed expected high neutron production in the temperature range that were consistent with Scaramuzzi's experiments. It is considered important for other laboratories with much better neutron-detecting equipment to run tests on neutron production from Pons-Fleischmann type cells using Pd cathodes. Such tests need to be run over a wide range of temperatures (which implies sealed and pressurized cells.)

TAIWAN - TRITIUM PRODUCTION

Chun-ching Chien (Institute of Nuclear Energy Research, Lun-Tan, Taiwan, R.O.C.), "Controlled Tritium Production by Electrolysis of D_2O", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHOR'S ABSTRACT

The tritium production reaction was found kinetically of pseudo zero order, it would proceed at a constant rate and might sustain for about 20-30 days. The rate was enhanced by the increasing of temperature or charging voltage. It was more effective and less disturbing to enhance the reaction rate by increasing temperature. The reaction could be interrupted (stopped) by switching voltage off for several hours and could revive again. The pretreatment of Pd rod before cathodic charging was the keypoint to the success of tritium production. Mild charging conditions of very low electric power input were favorable, while a too-violent voltage change would destroy and stop the reaction. Variation of charging voltage might trigger or quench the reaction. The probability for the tritium production over 3 orders of background was increased to over 50% under optimal conditions. It is believed that some optimal ways to excite the COLD FUSION phenomena might have been established.

EDITOR'S COMMENTS

These experimental findings are important because they represent one of the few cases where success has been achieved in turning a working cell "OFF" and having it revive later by turning in "ON". In addition, the paper emphasizes the important of pretreatment of the Pd rod.

JAPAN - LIMITS ON COLD FUSION

H. Ejiri, K. Matsuoka, and E. Choi (Dept. Phys. and Lab. Nuclear Studies, Osaka Univ., Japan), "Limits on Fast Neutrons From the Pd Cold Fusion by Means of Low Background Ge Detectors", Abstract submitted to Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

A low-background high-resolution Ge detector surrounded by neutron scatterers is shown to be used as a low-background neutron counter for fast (1 to 5 MeV) neutrons. The neutron flux and the energy are obtained by measuring yields of the beta-rays following inelastic scattering of fast neutrons from nuclei in a scatter and the beta-ray branching ratios, respectively. Detection efficiencies, including solid angles, are $(epsilon)_N$ = about 10^{-3}, and the minimum neutron source intensity

(sensitivity) to be detected is S_N = about 10^{-3}/sec., corresponding to the minimum neutron flux to be detected of $Y_N = S_N$ x $(epsilon)_N = 10^{-6}$/sec. We have performed experiments to test the recently claimed observation of the cold fusion by means of the newly developed low-background Ge detector system. Measurements were made for 73 hours by using Pd (59g) and Pt electrodes in the electrolysis of D_2O. We searched for the 847 KeV gamma ray following the inelastic scattering of the neutrons from ^{56}Fe in the iron scatters around the Ge detector. We observed no statistically significant excess of counts of gamma rays above the background. We have obtained an upper limit on the rate of $< 7.4 \times 10^{-25}$ fusions per deuteron pair per second for the d(d,n)^{3}He reaction in deuterided palladium. It should be emphasized that the Ge semi-conductor detector is very stable and sensitive, being free from noise and other disturbances. It measures a sharp gamma ray peak with the energy resolution of 2.5 KeV. Thus it is not confused with noise, discharge, and other backgrounds, which would give a low-energy bump rather than a sharp gamma peak.

EDITOR'S COMMENTS

This paper was not presented. The determination of upper limits on unobserved events add little information to the science of cold fusion. The calculations mean that if cold fusion had occurred (from a successful experiment) then the equipment could be expected to measure the results if the results exceed the limits. The abstract states that measurements were made for 73 hours. Bush and Eagleton's best experiment took three weeks to begin production of excess heat.

FLEISCHMANN, PONS, AND NEUTRONS
Abstract provided at conference. Paper not presented.

Martin Fleischmann (Dept of Chem, U/Southampton, England) & Stanley Pons (Dept. of Chem., Univ. of Utah), "Detection of Neutrons and Gamma-rays From Cells Containing Palladium Cathodes Polarized in Heavy Water", Abstract submitted to Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

In the preliminary paper giving our first account of evidence for nuclear reactions of deuterium electrolytically compressed into palladium cathodes [1,2] a part of the evidence was concerned with the generation of gamma-rays via the (n,gamma) reaction on the light water in the thermostats surrounding the experimental cells:

(i) $n + {}^1H \rightarrow {}^2D$ + gamma (2224 KeV)

Following the publication of the preliminary paper [1] we concluded [3] that measurements of the very weak spectra of the emitted gamma-rays are not feasible using sodium iodide detectors (such as that used in the original work) in the presence of the dominant background due to the daughter products of the uranium and thorium decay chains but that one should use instead high resolution (though lower sensitivity) germanium detectors.

In this paper we report on the detection of neutrons via reaction (i) using such a germanium detector and compare our results with other published attempts to measure such weak gamma-ray spectra; we comment on the further possible development of the method and relate our results to other measurements of low level neutron fluxes emitted by metal/deuterium systems.

References: [1] Fleischmann et al., *J. Electroanal Chem*, **261,** p301, (1989). [2] Errata Fleischmann et al. *J. Electroanal Chem*, **263**, p 187 (1989). [3] Fleischmann et al., *Nature*, **339**, p667 (1989).

RUSSIA - COLD FUSION RESEARCH

P.I. Golubnitchiy, A.D. Philonenke, A.A. Tsaric (Lugansk Machine-Building Inst., Moscow), V.A. Tsarev, (P.M. Lebedev Physical Inst., Moscow), "Correlation Measurements in Cold Fusion Experiments", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

We searched for double (neutrons and acoustics) and triple (neutrons, acoustic and electromagnetic radiation) correlation during D_2O Electrolysis with Pd cathode and thermocycling of D-loaded Pd samples (phase transitions). An acoustic [device was] used for mechano-thermal activation of LiD crystals. Cold Fusion in the primordial hydrogenous earth.

EDITOR'S COMMENTS

Prof. V.A. Tsarev gave an excellent review of cold fusion research in the USSR over the past five years. Cited were the early work on fracto-fusion where only a few neutrons were detected and gradually improving to recent work by Karabut et al. [*Fusion Facts,* Vol 2, No 10, p 1, (April 1991)] where bursts of up to 10^6 n/sec were reported. Tsarev noted that almost no calorimetry has been done but that about 80 papers were presented recently at a cold fusion conference. Tsarev reported that there had been a generally negative attitude in Russia toward cold fusion but that the climate is changing. Prof. Tsarev has agreed to submit a summary of the work in USSR to *Fusion Facts*. We look forward to publishing his contribution.

ITALY - MULTI-CELL EXPERIMENTS

D. Gozzi, P.L. Cignini & M. Tomellini (Dipartimento di Chimica, Universita "La Sapienza", Roma, Italy), S. Frullani, F. Garibaldi, F. Ghio, M. Jodice & G.M. Urciuoli (Lab. di Fisica, Istit. Superiore di Sanita and Sezione INFN, Roma, Italy, "Multicell Experiments for Searching Time-related Events in Cold Fusion", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

A new ten-electrochemical cell experiment is running in order to confirm previous results and to understand the key role of some experimental parameters in triggering cold fusion events. The experiment is designated to detect: a) heat excess; b) loading factor by *in situ* measurement of the cathode displacement; c) nuclear products: neutrons, tritium in the electrolytic solution and in the recombined heavy water, gamma-rays; d) effect of the palladium electrode preparation. To measure the heat excess, a calibration curve of the input power vs. the temperature of the solution was obtained for cells equal in the shape, materials and in the same experimental condition in which the experiment is now running. The unique difference lays in the cathode. The cathode used in the calibration measurements was made of palladium rod gold-plated by electrochemical deposition. The growth of the gold layer was carefully controlled by microprobe analysis to be sure that all of the palladium cathode surface was covered by gold. After that a further deposition of gold was done. In the multicell experiment one of the ten cells is a calibration cell previously utilized. This allows to have both a blank and to control the stability of the calibration curve. Two cells out of the ten are equipped by micro-displacement transducers which allow to measure the palladium swelling, caused by the deuterium loading, with at least 0.1 micrometer resolution. Neutron detector is a He^3 proportional counter, the same used in the previous experiments, but the data acquisition is now implemented by a fast pulse-shape storage and off-line discrimination for very accurate counting. The gamma-ray detection has also been improved by using a more efficient high purity Ge detector and a large NaI(Ti) monocrystal detector. Each of the cathodes is different from the others in shape, dimension, and preparation.

EDITOR'S COMMENTS

This is an excellent approach to multi-cell study of cathode parameters. With the additional information provided at the conference relating to fast "turn-on" times by plating the cathode with palladium black (Bush - China Lake) this new science may really be able to do excellent parametric studies. Gozzi reported that excess heat varied up to 46 watts/cu cm of Pd.

NEW YORK - GAS LOADING + ELECTROLYSIS

Evan Granite, Jacob Jorne & Howard Saltsburg (Dept. of Chemical Engineering, U. of Rochester, NY), "A Novel Method for Studying Electrochemically-Induced Cold Fusion Using a Deuteron-Conducting Solid Electrolyte", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

A new method for studying cold fusion is described, in which the electrolysis and the gas loading methods are combined. The apparatus consisted of a deuteron-conducting solid electrolyte (beta"-alumina disk) coated on both sides with porous palladium layers which served as electrodes. It allowed the application of an electrochemical potential in a deuterium gas-loading experiment. Deuterium gas was circulated through the cell which was maintained at 250 C and atmospheric pressure. An external voltage of 20V was applied to pump deuterons across the solid electrolyte (0.2 mA current) in order to produce a high activity of deuterium at the Pd cathode. Bursts of neutrons have been observed during the solid state electrolysis, although the questions of reproducibility, simultaneous background measurement and neutron energy spectrum must be addressed before assigning the observation to cold fusion. Solid state electrolysis using the same cell, in which hydrogen replaced deuterium, showed no neutron bursts. Temperature measurements, using a similar solid electrolyte cell, showed no excess enthalpy and **a limit of detection of 10^{-10} per D-D pair per second has been estimated.**

EDITOR'S COMMENTS

Evan Granite reported that the neutron/tritium ratio observed was in the range of 10^{-6} to 10^{-16}. We look forward to further reports on this new combination gas-loading and electrolysis method.

CHINA - RESEARCH SUMMARY

Zhou Hongyu, Wen Chenlin, Ron Yanin, Fan Guoying, Yan Hua, Zhou Weidong, Wang Dachun, Hua Ming, Liu Shuzhen and Han Zhuen (Institute of Low Energy Nuclear Physics, Beijing Normal University). Wu Zhongda, Yu Runhu and Liu Zhanghao (Chemical Department, Beijing Normal University), Ren Guoxiao (Institute of High Energy Physics, Chinese Academy of Sciences), "Some Results on Cold Fusion Research", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

We have measured a proton recoil spectrum caused by the neutrons produced in the electrolytic cell, which was similar to Fleischmann's. The neutrons more than 3000 counts were recorded during one hour. Because there is excellent neutron-gamma discrimination ability in the circuit, the rate of background counts was only about 70 counts/hour and the effect to background ratio reached 40:1. For comparison the proton recoil spectrum for $D(d,n)^3He$ reaction neutrons produced in the high voltage accelerator, energies of deuteron ions were 300 keV, was also measured by the same liquid scintillation spectrometer. Their maximal energies are coincident. In addition, abnormal concentration of tritium more than one time of tritium background counts has been observed at the same experiment. If $D(d,n)^3He$ reactions occurred in the electrolytic cell, the reasonable explanation can be obtained for above results.

Using plastic track detector CR-39, we carried out a new experiment and obtained interesting result. A plastic sheet attached to a Pd foil and another sheet attached to a Ti foil were put into a steel bottle, in which there were Ti chips of 50 g. After degassing the steel bottle to $2.5x10^{-4}$ Pa, D_2 gas of 2 atm. was bottled. After positioning the bottle at room temperature for 350 hours, two plastic sheets were taken out and etched. A large number of charged particle tracks were observed on the sheets. Preliminary analysis for these tracks shows that the charged particles more than two types have produced in the bottle. But similar tracks have not been found in the measurement of the background. The types and energies of these charged particles are being analyzed.

EDITOR'S COMMENTS

The Chinese experimenters have the same difficulty with replication as other scientists. The use of CR-39 plastic track detector is explained more fully by Ke L. Wang et al. (see below with gas-loading experiments.) The neutron counter efficiency for the above paper was reported to be about 0.1%. However, much better results are obtained with CR-39.

HAWAII - MOLTEN SALT UPDATE

Bor Yann Liaw, Peng-Long Tao, and Bruce E. Liebert* (Hawaii Natural Energy Institute, and *Department of Mechanical Engineering, University of Hawaii), "Recent Progress on Cold Fusion Research Using Molten Salt Techniques", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

We have demonstrated a novel elevated-temperature molten salt technique for generating high-level excess heat. More than 4MJ/mole D_2 of excess heat, at least 600% over the input power, was measured in two incidents using a torched Pd anode and an aluminum alloy cathode merged in a eutectic LiCl-KCl mixture saturated with excessive LiD at about 370C. No thermochemical explanation can account for this excess heat. Measurements on the hydrogen based system showed normal endothermal behaviors. The Pd samples were later examined for their morphological behaviors and for He analysis. A very porous microstructure of the samples was found. Electrolysis and deuteriding processes changed the morphology substantially. Enhancement of alpha-particles in the deuterated sample was detected while the hydrated sample showed an opposite effect. The amount of the alpha-particles in the sample, however, were not commensurate with the measured excess heat. On-line neutron (using BYU facility) and particle measurements (using ETEC/Rockwell facility) were planned and at work. Reproducibility of the experiments is poor to date.

EDITOR'S COMMENTS

This molten salt work previously reported [*Fusion Facts*, Vol 2, No 2, p 10, (August 1990)] is exciting for two reasons: excess heat as high as 1600% has been obtained and ^4He was found in the palladium electrode. Work is currently hampered by materials problems but good progress is reported. Replication is still poor.

CHINA - REVIEW OF COLD FUSION RESEARCH

Xing Z. Li (Tsinghua University, Beijing, China) "Chinese effort in understanding the Cold Fusion phenomena", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHOR'S ABSTRACT

Under the auspices of the Natural Science Foundation of China and the Science and Technology Committee of China, the cold fusion research has passed three phases: Hot, Quiet, and Deep-going phases. 1.) The hot phase started in March 1989. Most of the aficionados of cold fusion attempted to reproduce the "excess heat" or the anomalous neutron emission (among them the Beijing Normal University and the Chinese Academy of Engineering Physics were the first two groups to report their results in newspaper); however, the difficulties in reproducing these sporadic phenomena stopped most of these efforts. One experiment in this period is still worth being mentioned: i.e. the earliest gas-discharge-tube experiment in China, in which the energy spectra of the neutrons are measured at the Southwestern Institute of Nuclear Physics and Chemistry. Besides a peculiar

property of palladium tube under the high pressure-low temperature cycles was reported at the Beijing Institute of Physics also.

2.) The quiet phase started after the Santa Fe workshop and reached the lowest point when the D.O.E. Blue Cover report (DoE/S-0073) was published. Nevertheless, several groups kept going along different approaches. The Institute of Atomic Energy collaborated with Los Alamos lab and searched for recovery technique of "died" sample. The Tsinghua University group proposed the idea of the 'precursor of the cold fusion' and using the CR-39 (plastic track detector) to detect the energetic charged particles. It was found that the surface treatment with aqua regia on palladium samples might suppress the emission of energetic charged particles.

3.) The conferences abroad and in China in 1990 promoted the research into the deep-going phase. Carefully designed experiments were done at the Chengdu University of Science and Technology, and the Beijing Institute of Chemistry for searching the excess heat. Three sets of discharge tube experiments are running for detection of neutrons, charged particles. Sample treatment procedures are carefully studied at the Institute of Atomic Energy. Several theoretical models were proposed. Particularly, the di-neutron model was proposed by Hunan Normal University, based on the experiment at the Shanghai Institute of Nuclei. Xiamen University group is developing new equipment to analyze the trace of helium. More international collaborations were started at Tsinghua University in this period also. A real-time analysis of the radiations with energy spectra was done to understand the mechanism of "cold fusion" phenomena.

EDITOR'S COMMENTS

An interesting anomaly was reported: In a gas-discharge experiment using Pd (1.7 x 80 mm with 4 Kv at 3 mA) neutrons were produced at the rate of 6.5 x 10^4 n/sec. An unexplained blue glow was seen around the tip of the Pd electrode. Dr. Li reported that work has proceeded in 13 Chinese cities and that two workshops have been held. One of the findings was that cleaning Pd with aqua regia may cause a Cl poisoning of the Pd electrode.

ITALY - GOOD TRITIUM DATA

G. Mengoli, M. Fabrizio (IPELP-CNR, Padova, Italy), C. Manduchi, L. Riccardi, G. Zannoni (Dip. Fisica "G. Galelei", Padova, Italy), A. Buffa (IGI-CNR, Padova, Italy) "Tritium and neutron emission in the electrolysis of D_2O at Pd and Ti Cathodes" (work performed in collaboration with ENEA, Frascati, Italy), Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

Cold fusion electrolytic experiments carried out in Padova since March 1990 are outlined. The research was initially focused on the possible generation of ^3H in the electrolyte (D_2O/0.1 M LiOD); the experimental design consisted of several cells, equipped with similar Pd sheet cathodes (area 1-2 cm^2; thickness 0.005 - 0.05 cm) and Ni coil anodes, run all at once in series. ^3H was determined by counting beta-decay of the solution with liquid scintillator using a specially constructed spectrometer which allowed beta-energy spectra identification and corrected counting for chemiluminescence and spurious counts. It was thus found that after a few days of electrolysis at 50 mA per cu. cm. although sporadically, tritium could increase to about 1 order of magnitude above the initial level (400 dpm against 40 of D_2O). In a further research stage the identification of neutrons, if any, from the experiments was also aimed. To this end 1-2 cells were assembled inside the cavity (solid angle 4 pi) of NE 213 proton recoil liquid scintillator (4500 cu. cm.) spectrometer; neutron energy spectra were collected by 3 in coincidence photomultipliers (>95% gamma-ray anticoincidence); the efficiency (^{252}Cf standard) was 0.5% and later reduced to 0.35%. Therefore 3 electrolytic cells on 4 (cathodes Ti, Pd; electrolytes D_2O/NaOD, $LiSO_4$, LiOD) run in turn from November to March 1991 evidenced ^3H levels in solution as well as in the recombined gas, which are not accounted for by electrolytic separation. A quantitative evaluation of the neutron flux from these cells could not be tried owing to its low intensity compared to background (100-50 n/s +/-20%). However, from statistical analysis of the frequency of radiation recorded either in the electrolyses or in long blank experiments (we used a 2-5 s for channel multiscaler) it appears that during the electrolyses the background is overlapped by a neutron flux of higher frequency. In other words, the frequency of the neutrons recorded when the electrolyses are running never showed the Poisson distribution typical of the background. At present, an alternative electrolytic route to the induction of nuclear phenomena is followed: current density at a low dimension Pd cathode (0.5-0.7 cm, diam. = 0.1 cm) is increased till causing local plasma discharge (contact glow discharge electrolysis). The phenomenon, observed in our conditions for 300-500 V and 0.5 A per sq cm applied, inter alia gives rise to strong cathode overheating. Fluxes of 40-50 n/s and more were measured in some typical experiments.

EDITOR'S COMMENTS

This and other tritium-producing experiments should be pulling out the "nails driven into the coffin of cold

fusion". Of considerable interest is the strong cathode overheating during the contact glow discharge electrolysis.

U. S. NAVY - FINDS ^{4}He IN EFFLUENT GASES

M.H. Miles, G.S. Ostrom (Chem Div, Naval Weapons Center, China Lake,CA) B.F. Bush, & J.J. Logowski (Dept. of Chem, U. of Texas, Austin), "Heat and Helium Production in Cold Fusion Experiments", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

A critical issue in determining whether or not the cold fusion process exists is the quality of the evidence concerning the composition of the gaseous products. The lack of neutrons, gamma-rays, and other forms of radiation in these experiments has prompted theoretical proposals of fusion processes in the Pd-D lattice that yield only heat and helium as products. Calorimetric evidence of excess heat production during the electrolysis of heavy water using a palladium cathode will be presented. Effluent gas samples collected during episodes of excess heat production and sent to the University of Texas for analysis by mass spectrometry showed the presence of helium-4. Furthermore, the amount of helium detected was within experimental error of the theoretical estimate of helium production. Various control samples gave no evidence for helium. Attempts to measure the neutron activation of metal foils in cold fusion will also be discussed.

EDITOR'S COMMENTS

This work [previously reported in *Fusion Facts*, Vol 2, No 9, p 1 (March 1991)] is one of the most important experimental findings that have been reported. Although the experiment was designed to measure the expected ^{3}He predicted by Schwinger's theory, ^{4}He was found in amounts roughly equivalent to the excess heat developed. As shown by Dr. Robert Bass, a modification to Schwinger's theory accounts for the production of ^{4}He.
An outstanding new discovery was also announced by Dr. Miles: the latest electrochemical cell used a Pd cathode plated with palladium black and produced excess heat the first day!

The U.S. Navy can take great pride in the cold fusion work done by Miles et al., by Szpak (NOSC) and by Chubb (NRL) in making large experimental and theoretical strides in cold fusion. By contrast, the DoE hasn't found out that cold fusion is real.

JAPAN - LARGE Pd CATHODE RESULTS

H. Numata, I. Ouno (Tokyo Institute of Technology), R, Takagi (Research Lab. for Nuclear Reactors, Tokyo), K. Kawamura (Inst. of R&D, Takai Univ., Kanagawa), S. Haruyama (Tokyo National Col. Of Tech., Tokyo, JAPAN), "Neutron emission and surface observation during a long-term evolution of deuterium on Pd in 0.1 M LiOD", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

Long-term cathodic discharge for a well annealed thick Pd rod (21.2 diam. x 32.4 mm long) in 0.1 M LiOD has been performed to examine anomalous phenomena in relation with Pd/D system. An electrolytic cell (Quartz, 130ml) has a water jacket where the temperature of circulating water was controlled by cooling. The temperature of the electrolyte was kept at 45 and 50C. Two thermocouples were set on the Pd rod surface and outside of the counter electrode. Neutron emission was monitored by an NE213 scintillator. Rise time distribution of the NE213 was measured for neutron and gamma-ray, then a lower discrimination level for neutron set at the position were the rise time distribution has a maximum value for neutron keeping the response to gamma-ray as low as possible. Experiments have been carried out on Pd rods of 9.0 mm dia x 53 mm and 21.2 mm dia x 32.4 mm long which were annealed under vacuum at 10^{-6} torr, 800C and acid etched. Further, the rod was kept in D_2 for one day. The result of the thicker one is reported. The electrolysis was performed galvanostatically where the constant current densities were step by step raised up to 102 mA sq. cm. The count rate of neutron (CRN) bunched for 3h shows no significant increase in the beginning of discharge (Aug.5 - Sept.5) at less than 51.2 mA. High CRN appeared few days later after the current was increased to 102.4 mA and the temperature was raised to 50C. Meteorological data on CRN indicates that maximum deviation from the mean value does not exceed 30% of the mean value. Appropriate three energy spectrums were averaged during the periods of high CRN observed. The spectrum obtained by subtracting the background spectrum (scaled counts per minute) is shown in Fig. 1 [of paper] together with that of monochromatic 2.45 MeV neutron (dotted line). The significant signal above the background strongly supports the occurrence of a fusion in Pd/D system. SEM observation of Pd rod reveals that the discharging for 8 months not cause any crack but much of straight and twisted slip bands and two of long faults resulting a swelling.

JAPAN - NEUTRON BURSTS

M. Okamoto, N. Takahashi and Y. Fujii, "Anomalous neutron burst in heavy water electrolysis" Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

We have carried out a series of experiments to examine the anomalous neutron burst occurred in the electrolysis of the heavy water with Pd cathode. Many types of Pd cathodes have been examined as to the neutron burst. The Pd cathodes were heavily loaded with deuterium gas prior to the electrolysis. The electrolysis system was monitored by a neutron counting system consisting of 5 ^{3}He counters which were inserted in the polyethylene blocks and the counting efficiency was evaluated to be 1.0% using a standard ^{252}Cf source. Recently, we performed 18 electrolysis experiments using 10 kinds of Pd cathode in their shapes. Only two of them gave neutron burst evidently. In one of the two, we used a spiral Pd wire of 30 cm in total length and 2mm diam. and this gave a slight neutron number such as 10 times of the standard deviation. In the other case, Pd rod of 5 mm diam. and 4 cm long was used as the cathode. Five times neutron bursts were detected after 22 hr. 40 min. from the start of operation with 6.3 alpha, the second burst at 44 hr. 50 min. with 5.6 ~ 11.8 alpha neutrons, the third burst at 70 hr. 30 min. with 5.6 alpha, the fourth at 90 hr. 10 min with 45.3 alpha, and the fifth burst at 136 hr. with 13.2 alpha ~ 135.1 alpha, respectively. The five neutron bursts occurred periodically and the rates of neutron burst increased from the first burst (ca. 5.1 n/sec) to the fifth burst (ca. 130.4 n/sec). [1 missing line from abstract. Ed.]

ROMANIA - TRIGGERING MECHANISM ?

Evelina Palibroda, Peter Gluck (Institute of Isotopic and Molecular Technology, Romania) "Cold nuclear fusion in thin foils of palladium", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

Positive evidence for cold nuclear fusion in an electrochemical cell with a palladium thin foil cathode was obtained. After introduction of thiourea in the cell, seven successive emissions of neutrons (detected as thermal neutrons) alternating with inactive periods were recorded. The maximum intensity (300 times background) and duration (12.7 hours) were attained in the fifth emission. During the active periods by using the same measuring head at a distance of 1.5 m from the cell, neutron emissions very near to the background level were measured. It is highly improbable that such a sequence of events which has an evident internal logic should be the effect of some external cause, it seems to be rather correlated to a critical state of palladium. The trigger mechanism is probably a massive poisoning of the Pd surface with sulphur. Further studies are in due course in order to contribute to the achievement of the most important current objective of cold fusion studies: reproducibility.

EDITOR'S COMMENTS

Palibroda reported that the maximum count occurred after about 60 hours of electrolysis. We welcome this second laboratory from Romania to verify the existence of cold fusion.

UTAH - F&P NOW WORKING IN FRANCE
(Utah still claims these great scientists)

Martin Fleischmann (Dept. of Chemistry, University of Southampton, UK) and Stanley Pons (Dept. of Chemistry, University of Utah, USA), "Calorimetric measurements on palladium based cathodes polarized in heavy water", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

The major measurement technique which we have used in our investigations of the anomalous behavior of palladium cathodes polarized in heavy water has been the calorimetry of these systems. Three types of signatures were detected in our experiments up to October 1989:
1. Low to medium levels in the rates of excess enthalpy generation (0.1 - 100 watts per cu. cm., 5-40 % excess of the rate of enthalpy input to the cells);
2. Increases of the rates of excess enthalpy generation with decreases of the rates of enthalpy input; and
3. Bursts in the rates of excess enthalpy generation lasting for periods of a few hours to 16 days (typically 10 watts per cu. cm., 1000% excess of the rate of enthalpy input to the cells).
It is the magnitudes of the excess enthalpies (typically 50 MJ per cu. cm. in the base line values and up to 16 MJ per cu. cm. in the bursts) which demand explanations of the phenomena in terms of anomalous nuclear processes in these solid state systems. We have continued to use calorimetry as a major method of investigation in the period since October 1989. In this paper we describe the various types of signature which are readily observed using such measurements. We report on the observation of a pattern of behavior intermediate to that of the base line generation of excess enthalpy and the enthalpy bursts which can be observed with some types of cathode materials.

EDITOR'S COMMENTS

At every cold fusion conference there are rumors and speculations as to the latest developments achieved by these famous pioneers of cold fusion and always followed by disappointment that more specifics were not provided in terms of a recipe for cold fusion. The following items were of interest: 1. Now silvering the sides of cell to eliminate some losses. 2. Cell seals have been improved for further immersion. 3. Calibration errors are established to be no more than 2.72% 3. Now using a Pd/Ag alloy, reportedly the special alloy manufactured by Johnson-Matthey for hydrogen recovery ($Pd_{77}Ag_{23}$.) 4. They are currently having excellent results working in a laboratory in Nice, France (to provide more freedom to get their experimental work accomplished.)

During the time allocated to Dr. Pons, Dr. Wilford Hansen (Ut State U & member of Utah State's governor's energy/fusion advisory committee) was invited to report on his independent evaluation of Fleischmann-Pons data. Hansen reported that his careful analysis provided essentially the same amount of excess heat as computed by Fleischmann and Pons. (Note: On Monday, July 15, 1991 Dr. Hansen made a further report to the Utah governor's advisory committee. Using the measure of 5 eV of energy per Pd atom as sufficient to vaporize the Pd, Hansen indicated that in two of the sets of experimental data provided to him by Fleischmann and Pons the excess heat generated exceeded 2,000 eV per Pd atom.)

JAPAN - SUCCESS WITH PULSING

A. Takahashi, I. Iida, T. Takeuchi, A. Mega, S. Yoshida and M. Watanabe (Osaka University, Japan) "Neutron spectra and controllability by PdD/electrolysis cell with low-high current pulse operation", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

To attain good reproducibility of excess neutron emission from Pd/D cell, a series of pulse electrolysis experiments has been carried out changing the periodic wave function, repetition period, current and voltage. A 20 mm diam. 30 mm long Pd rod (cold worked) was used, in the series experiments, as cathode for more than 3 months. Neutron spectra, time-correlations between neutron counts and periodic current of electrolysis, evolution of excess neutron counts, tritium activity in electrolyte and cell temperature were observed. After about 1.5 months for D-charging, we have compared excess neutron count rates by changing pulse rate period as 4 min., 18 min., and 90 min.; maximum excess neutron emission rates (1.5 times the background) was observed for the 18 min. period operation with sawtooth (0 to 2 A), where observed neutron spectra had a 2.44 MeV peak (by d-d reactions) and a 3-6 MeV broad peak (probably by d-d-d reactions). From the third month, we started a repetitive square wave operation with 6 hr. low current (0.1A, 2V) and 6 hr. high current (2.8A, 20-30V), which induced the cell temperature change from about 25 to 60 C periodically. In all (more than 35) sweeps of the low-high current operation with 12 hr. period, we observed almost always (except one sweep) about twice higher excess neutron emission rates in high current intervals than those in low current intervals, though count rates in low current intervals increased gradually in later sweeps. **This result would show that the system was in control for "cold fusion" reaction.** We are measuring two neutron spectra separately in the low and high current intervals, which will make reaction types clear. We also observed that tritium activity increased to be more than 1.5 times the background, from the 3rd month. Sometimes, unknown temperature rises were observed.

EDITOR'S COMMENTS

In his conclusions Dr. Takahashi related that about a 12-hour turn-on time can be expected; that there were two neutron energy levels measured (at 2.45 Mev & 6-8 Mev), and that significant tritium is produced.

UTAH NCFI - TRITIUM EVERY TIME

F.G. Will, K.Cedzynska, M-C. Yang, J.R. Peterson, H.E. Bergeson, S.C. Barrowes, W.J. West and D.C. Linton (National Cold Fusion Inst., University of Utah, USA), "Studies of electrolytic and gas phase loading of palladium and deuterium", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

Highlights are presented of recent results obtained on the deuterium and hydrogen loading of palladium both in electrolytes and in the gas phase. Experimental approaches are described to achieving deuterium to palladium loading ratios in excess of 1.0. The electrochemical cell design allows continuous determination of the loading ratio and observation of temperature excursions of the palladium electrode with a sensitivity of .05C and a response time of a few seconds. Light water controls are run simultaneously with heavy water cells. Neutron generation is monitored with helium^3 detectors, employing electronics that enables neutron bursts to be observed within a time window of eight microseconds. Gas, electrolyte, and electrodes are analyzed for tritium. Gas phase experiments of the Wada-type have been performed on palladium, using electrical

discharges to activate the palladium. Neutron bursts up to 280 neutrons in 120 microseconds and tritium enhancements in the palladium of up to 25 x background have been observed in the palladium.

EDITOR'S COMMENTS

This paper was given the day after the official closing of the NCFI (for lack of financial support from government and/or industry). Dr. Will reported that in the final series of experiments, tritium was produced in four of the last four cells. Tritium production was as high as fifty times background. **No tritium was produced when the D/Pd ratio was less than 0.85.**

CHINA - ^{4}He PRODUCTION QUITE POSSIBLE

Q.F. Zhang, B.Y. Mu, Z.H. Zhu, Q.Q. Gou (Inst. for Atomic and Molecular Science at High Temperature and High Pressure, Chendgu University of Science and Technology, China), "The titanium cathode-electrolysis study in cold fusion.", Abstract submitted to Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

We have made two types of electrolytic devices to study "excess heat" and "products" of cold fusion. One of them consists of a Ti-cathode of 3.0 mm dia. with Pt wire wound around Ti rod. The current density for the electrolysis is 64mA per sq. cm. and the heavy water solution is adjusted to 0.1N NaOD as electrolyte. The other is a Ti-cathode of 12.0 mm dia. with a sheet Pt-anode around the Ti-cathode. Its current density is increased to 250mA per sq.cm., however, the heavy water solution is the same as before. The temperature of Ti-rod is measured by thermocouple with good thermal contact between them. After 92 and 72 hours, the temperature of surface of Ti-rod starts to go up pulsatily and continuously for 12 hours and 7 hours respectively. The maximum pulse values of temperature of Ti-cathode is 3C and 24C. In the same time, the temperature of the heavy water was not changed significantly during the whole duration. The possible fusion products have been measured by SIMS (second ionization mass spectroscopy) and liquid simulation counter. The mass number 4-like species was observed in the immersed Ti-rod sample. On the other hand, the mass number 4-like species was not observed in Ti-rod sample which was above the surface of heavy water solution. The possible tritium in the heavy water was measured by liquid scintillation counter two months later. The background count was 506 and the used electrolyte count was 744. Therefore, the main reaction D+D --> ^{4}He* --> ^{4}He + 23.84 MeV will be quite possible.

EXPERIMENTAL, GAS LOADING
(16 Abstracts Submitted)

COLORADO - PARTICLES FROM D-LOADED Ti

D.H. Beddingfield, F.E. Cecil, C. Galovich, H. Liu and T. Kuhlmann (Colorado School of Mines, USA) Sally Asher (Solar Energy Research Institute, USA), "Characterization of charged particle bursts from deuterium gas loaded thin Titanium foils.", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

We have continued our investigation of previously reported bursts of charged particles using Si surface barrier detectors from deuterium loaded Ti alloy thin metal foils which had been temperature cycled to -180 C and subjected to moderately high current densities (100 mA sq. in.). We have since developed a CAMAC based particle identification system in an effort to identify the nature of the charged particle bursts. Results of this effort will be presented. We have similarly carried out extensive analyses of the samples which had previously evinced charged particle bursts. Analytical techniques employed include Secondary Ion Mass Spectrometry (SIMS), X-ray diffraction (XRD), Neutron Activation Analysis, Electron Dispersive Spectrometry (EDS), Scanning Electron Microscopy and single gravimetric analysis. These analyses have afforded us a fairly complete understanding of both the structure and elemental composition of the samples and are particularly sensitive to differences between those samples which yielded bursts of charged particles versus those which didn't. In addition our analyses provided a quantitative determination of the deuterium-metal ratio. A related study has yielded the thermodynamic phase diagram for Ti(6%V-6%Al-2%Sn), the titanium alloy used in our charged particle burst studies. This work was supported by EPRI.

EDITOR'S COMMENTS

Dr. Cecil reported that a summary plot of experimental results (measuring neutrons from Ti) showed an exponential drop over a period of several months. Why? No explanation was given by author or audience.

ITALY - D-Ti NEUTRON MEASUREMENTS

T. Bressani, D. Calvo, F. Iazzi, C. Lamberti and B. Minetti (INFI Sez di Torino, Italy) R. Cherubini, A.M.I Haque and R.A. Ricci (Laboratori Nazionali di Legnaro, Italy), "Observation of 2.5 MeV Neutrons emitted from a

Ti-D system.", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

We measured by means of a neutron spectrometer based on the double scattering and time-of-flight technique the neutron spectra emitted from a Ti-D_2 system. The Ti-D_2 system consisted of a cell containing about 3 gr of Ti shaving, filled with D_2 gas. Temperature cycles from 30 to 540 C could be performed by means of a suitable heater; the temperature of the cell was monitored by a calibrated thermocouple in contact with the bottom of the cell. The typical cycles consisted of about 1.5 hr. ramp up in temperature followed by about a 2.5 hr. stay at 540 C, a 4 hr. ramp down followed by about a 18 hr. stay at 30 C. We performed about 15 cycles with the cell filled with D_2 and about the same number of cycles with a filling of H_2. In the D_2 cycles we observed a small but significant increase of counts of neutrons around 2.4 MeV. The subtraction properly normalized, of the H_2 cycles, showed an enhancement of the channel at 2.5 MeV, but with a shape of the subtracted background not very clean. This could be attributed to the fact that measurement with H_2 started about 20 days after the measurement with D_2, and the same not-controlled source of uncertainty could be present by this method. A better signal was obtained by subtracting the cycles with D_2 ramp up, properly normalized, to the cycles with D_2 ramp down. The spectrum is shown in Fig. 1 (of the paper). The same spectrum for the H_2 filling did not show any significant effect. The width of the peak is fully consistent with that one evaluated by a Monte Carlo simulation of the spectrometer response. The neutron emission, taking into account the detector efficiency, as measured by this experiment, is about 2 neutrons/s integrated over the whole period of measurements.

EDITOR'S COMMENTS

Dr. Bressani reported that they have been using Ti sponge since early 1991. No important bursts have been observed but some degree of reproducibility has been achieved. Dr. R.T. Bush suggested that they may want to ramp slowly through some of the important temperature bands. Bush's TRM predicts that neutron emission is strongly affected by temperature and there are many bands of preferred temperatures for neutron production.

ITALY - FUSION IN SUPERCONDUCTORS

F. Celani, A. Spallone, L. Liberatori (INFN, Lab. Naz. Frascati, Roma Italy), F. Croce, L. Storelli (Univ. di Roma, Italy), S. Fortunati, M. Tului (CSM ILVA-IRI, Italy), N. Sparvieri (ALENIA-IRI, Italy), "Search for neutron emission from deuterided high temperature superconductors in a very low background environment.", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

In the framework of Cold Fusion experiments we proposed, in May 1990, a new kind of experiment in order to study neutron emission (if any) in partially deuterided high temperature superconductors (HTSC). Experiments were performed in the low background environment of the Laboratori Nazionali del Gran Sasso (Italy), using as neutron detectors two low-intrinsic background stainless-steel 3-He detectors previously used for ultra-low level neutron measurements in the same laboratory. The HTSC samples (typically 20-50 gr) were deuterided by loading them at high pressure (20-40 bar) and at temperatures from 95 to 150 C for several hours. The most extensively studied superconductor was $Y_1Ba_2Cu_3O_7$ specially processed by ozone enriched oxygen atmosphere during annealing and sintering. We performed two kinds of experiments: one searching for spontaneous emission during thermal cycles from liquid nitrogen temperature to room temperature; the other looking for stimulated neutron emission using a low intensity (2.2 KBq) Am-Be neutron source at room temperature. We have used a dedicated circuitry to detect correlated events using two separated time windows from 0 to 110 microseconds and from 110 to 1100 microseconds on both detectors. We have searched for multiple neutron counts in both time windows during thermal cycles and pressure loading. We have observed significant differences in respect to the background only when temperature or pressure were rapidly changing, and only in the time window up to 110 microseconds. This effect does not yet have a great level of reproducibility and its systematic study is still under progress.

[Dr. Celani reported that non-equilibrium conditions were necessary to obtain nuclear signals. Ed.]

NEW MEXICO - LANL & TRITIUM PRODUCTION

T.N. Claytor, D.G. Tuggle & H.O. Menlove (Los Alamos Nat'l Lab), "Tritium Generation and Neutron Measurements in Pd-Si Under High Deuterium Gas Pressure", Presented at the Second Annual Conference on Cold Fusion, June 29-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

Evidence has been found for tritium production in palladium and silicon stacks when pulsed with a high electric current. These palladium-silicon stacks consist of alternating layers of pressed palladium powder or foil and silicon powder or silicon wafers. A pulsed high electric

current is thought to promote non equilibrium conditions important for tritium and neutron production. Over 4000 hours of neutron counting time have been accumulated in a low background tunnel with high efficiency counters (20%). Recently, the counter was moved to a very low background environment deeper in the tunnel and low background stainless detector tubes were placed in the counter resulting in a overall reduction in the background by a factor of 12. The correlated counting rate has also dropped by nearly a factor of 6. At this time, only a modest amount of data has been obtained with this new counter configuration. In the old configuration neutron emission occurred as infrequent bursts or as low level emission lasting for up to 20 hours. In twelve of 35 powder cells, excess tritium greater than 3 sigma has been observed. Recently very low tritium [content in] deuterium has been used in all of the experiments and has shown that current rather than voltage is the dominant factor in tritium production. In the most recent tests the amount of tritium produced has been up to 150 times the total tritium inventory in the gas cell. Cells have shown reproducible tritium generation at levels from 0.02 to 0.8 nCi/hr. Several hydrogen and air control cells have been run with no anomalous excess tritium or neutron emission above background. In the powder system, the ratio of tritium produced to total integrated neutrons detected has been anomalously high. A significant amount of the total palladium inventory (25%) has been checked for tritium contamination by three techniques revealing that there is no detectible contamination in the virgin palladium.

EDITOR'S COMMENTS

Tritium/neutron ratio measured to be about 10^8. Fleischmann noted that tritium would be released preferentially from Pd powder. The best results have been achieved using palladium coated with an "enhanced oxide." If tritium can be produced economically by cold fusion techniques, the U.S. government would not have to build the currently-planned nuclear plant estimated to cost well over $100 billion. DoE would be well advised to fund an intensive cold-fusion tritium production effort.

CHINA - SEARCH FOR CHARGED PARTICLES

Da-Wei Mo, Shi Y. Dong, Ke L. Wang, Bo X. Chen, Xing Z. Li (Tsinghua Univ, Beijing, China), "Search for Precursor and Charged Particles in Cold Fusion", Presented at the Second Annual Conference on Cold Fusion, June 29-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

A special gold-silicon surface barrier detector is used in gas-loading experiments (Frascati type) to detect the precursor and charged particles in cold fusion. Based on the previous experiments [Xing-zhong Li, et al., *Fusion Facts*, Vol 2, No 5, p 49, (November 1990)], an improvement is made in the measurement of the time dependence of the signals of radiation by using two multiple channel amplifiers with time sequential records. Particular efforts are made to lower the energy threshold for low energy photons. Meanwhile, the system is adjustable to also scrutinize the energetic charged particles. It is capable of detecting charged particles (protons, tritons, helium 3 or helium 4 etc.) with energy range from 1 MeV to 22 MeV. Preliminary experimental results with deuterized palladium and titanium samples will be presented, including the variation of energy spectra during the temperature cycles, the bursts of low energy radiation, and the components of high energy charged particles.

EDITOR'S COMMENTS

Dr. Da-Wei Mo reported that palladium obtained from Russia in the 1950's provided more particles than did palladium obtained from the U.S. It was suggested that the Russian palladium may have been contaminated with tritium. [From nuclear bomb tests, perhaps.]

ITALY - NEUTRONS AND TRITIUM

A. De Ninno, A. Frattolillo, F. Lanza (JRC EURATOM), C. Pontorieri, F. Scaramuzzi, P. Zeppa (ENEA, Frascati, Italy), "The Production of Neutrons and Tritium in Deuterium Gas-Titanium Interaction", Presented at the Second Annual Conference on Cold Fusion, June 29-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

The emission of neutrons from a titanium-deuterium gas system has been detected in experiments performed in the Spring of 1989 [DeNinno et al. *Europhysics Letters*, **9**, 221 (1989)]. One of the most striking features was the structure in bursts (duration of about 100 microsec) of the neutron emission. Using a detection system proposed by a Los Alamos Group [Menlove, *Proc of First Ann Conf on Cold Fusion, Mar 1990,* pg 250], suitable to analyze the structure in bursts of the emission, a preliminary set of measurements has been performed with satisfactory results [F. D'Amato et al., *Proc of First Ann Conf on Cold Fusion, Mar 1990,* pg 170]. A better tailored detector is now in use in a low neutron background setup (INFN, Lab Nazionale del Gran Sasso). The first results of this experiment will be presented. Furthermore, the search for tritium excess in the samples used for neutron detection has been continued, with the technique described in above reference. Also these results will be reported.

CHINA - RESULTS FROM ION-IMPLANTATION

Shuyun Duan, Weishu Guan, Shiqing Cheng, Jun Zhang, Shuli Hao, Biao Gu, Jiaquan Li, Wenxue Liang, Guangyang Zhang, Sixiu Pei, Juncheng Huang, Kangwei Cheng, Rong Liu, Xirong Liu, Ying Li (Southwestern Inst of Physics, Sichuan, China), "Fusion Neutron Emission Induced by Injection of Deuterium into Titanium Target in Plasma in a Mirror", Presented at the Second Annual Conference on Cold Fusion, June 29-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

A target, titanium sheet laden with deuterium, is immersed in the deuterium plasma confined in MM-2U magnetic mirror and the target is biased to a high negative voltage about 10 kv. The deuterium nuclei-deuterons are infused into the crystal structure of titanium target. **After about three and a half hours' implantation**, random neutron emissions are observed and neutron bursts are measured by using two identical BF neutron detectors No. 1 and No. 2 located at different positions and a neutron dosimeter. The neutron count rates are 10^2 higher than the background rates of 0.8 counts/sec. It is corresponding to neutron flux of (2-5) x 10^5 neutron/sec. No gamma-ray counts above background are detected in our experiments. It is suggested that random neutron bursts may be from cold nuclear fusion reactions related to the propagation of microcracks of the metal lattice.

EDITOR'S COMMENTS

This work began in 1989 and continued for one year. The plasma-induced burst of neutrons included the following: 9 x 10^4 n/sec and 6 x 10^5 n/sec for about 10 minutes; 5 x 10^5 n/sec for 5 minutes; and 5 to 8 x 10^5 n/sec for 15 minutes. We hope that this work can be continued and measurements made to observe T/n ratios.

CHINA - NEUTRON BURSTS USING CR-39

Shang-Xian Jin, Fu-Xiang Zhang, De-Cheng Yiao, Qi-Bang Wang & Bai-Lu Wu (Dept. of Physics, Academia Sinica, Beijing, China), "Anomalous Nuclear Effects During the Gas Discharge of Pd/D System", Presented at the Second Annual Conference on Cold Fusion, June 29-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

A burst of nuclear products of (2-3) x 10^5 per sec has been repeatedly detected by using CR-39 solid state track etch detector and a BF_3 detector during a high-voltage discharge between palladium rods well soaked with deuterium. The number density of nuclear tracks on the CR-39 which were stuck to inner wall of the glass discharging tube were far more than from the CR-39 stuck to outer wall. This indicates that except for the neutrons a large number of charged particles were produced [within the glass wall]. No anomalous effects were found in the control experiments of Pd-H system compared with Pd-D system in the same experimental conditions. It is concluded that some anomalous effects definitely occurred in the Pd-D system.

EDITOR'S COMMENTS

High neutron bursts of 10^4 to 10^6 n/sec have been observed. The CR-39 is exposed for a given period of time and then etched with NaOH and examined with a microscope. The gelatin material is highly sensitive, the cost is low, and one can learn to observe signatures in the gelatin from various types of nuclear events. It helps to take good photographs of the CR-39 and work from photos or enlargements. The CR-39 was tried using a sandwich of Mn, Pd, and Au. 100,000 tracks per sq cm were observed in the CR-39. A comment was made that the CR-39 purchased from England proved to be the best material.

ITALY - TRITIUM FROM TANTALUM

F. Lanza, G. Bertolini, V. Vocino, E. Parnisari, C. Ronsecco (Commission of the European Communities, JoinT Res. Center, Ispra, Italy), "Tritium Production Resulting from Deuteration of Different Metals and Alloys", Presented at the Second Annual Conference on Cold Fusion, June 29-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

Previous experiments have shown that tritium production is obtained in deuterating titanium. However, the data obtained are highly scattered and non-reproducible. In order to try to define better the phenomenon a series of tests have been performed using various metals and alloys and different deuterating conditions. Sheets and shavings of titanium, zirconium, hafnium, tantalum, and Ti-Zr 50% alloy have been tested. The deuteration parameters which have been taken into consideration are the rate and temperature of deuteration, deuterium stoichiometry, thermal cycling to liquid nitrogen temperature and isotopic purity of the deuterium. The tritium production is evaluated making the difference of the tritium content in the deuterated metal and the initial content of tritium in the deuterium gas. The amount of tritium produced is low and reproducibility is rather poor. A statistical analysis shows that significant differences exist only for the type of metal used. In general, it appears that the tritium production increases with the increase of the

atomic number of the metal. The best results have been obtained using tantalum sheet. Also the Ti-Zr alloy gives interesting results. During the deuteration the autoclave was monitored in order to detect possible neutron emission using a system composed by 18 - ^{3}He tubes. No significant emission was detected. Taking into account the standard deviation of the neutron background and the maximum tritium production it appears that the tritium to neutron ratio is < or = 3×10^{-6}. [Sic. Undoubtedly a typing error in the abstract and should be 10^{6}. Ed.]

NEW MEXICO - LANL & NEUTRONS

H.O. Menlove, M.A. Paciotti, T.N. Claytor & D.G. Tuggle (Los Alamos Nat'l Lab), "Low-Background Measurement of Neutron Emission from Ti Metal in Pressurized Deuterium Gas", Presented at the Second Annual Conference on Cold Fusion, June 29-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

During the past two years, we have performed experiments to measure neutron emission from pressurized D_2 gas mixed with various forms of titanium metal chips and sponge. Details concerning the neutron detectors, experimental procedures, and results have been reported [*J. Fusion Energy,* **9,** p4, (1990); and *Nucl Instr Meth*, **A-299,** 10-16 (1990).] Our recent experiments have focused on determining a trigger mechanism for the anomalous low-level neutron emission. Thus far we have been unsuccessful in isolating a trigger mechanism, although we have measured several samples that yielded excess neutrons above background. To improve our detection sensitivity, we have increased the shielding in our counting laboratory and we have located additional detector systems in deep underground counting stations at Los Alamos and Leadville, Colorado. We are using ^{3}He neutron detectors in a CH_2 moderator. The overall efficiencies range from 20% to 44% for the four separate detector systems that are operating in parallel experiments. Two of the detector systems are segmented to provide separate signal outputs for a consistency check on the origin of the signals. We measure both single (random) neutrons and time-correlated (coincidence) neutrons. Our coincidence background is dependent on the detector and shielding location and ranges from 2.9 counts/h to less than 0.5 counts/wk in the deep mine locations. This paper will present an update on our experimental results with a focus on our most recent results. Data will be shown from sample DD-17 that was measured with the detector system in the low-background underground tunnel at Los Alamos. The corresponding background coincidence rate is 2 counts/day. The high neutron activity level (over 7,000 counts in bursts) occurred during a 48-hour period following the eleventh liquid nitrogen (LN) cycle for this sample after 32 days of measurement. Many repeated LN measurement cycles of this sample yielded no excess neutron emission.

EDITOR'S COMMENTS

Dr. Menlove presented a review of neutron detection. Achievements in various locations have ranged from 10^{-3} n/s at LANL; 10^{-5} at Leadville, Colorado; 10^{-4} at Beijing; 10^{-5} in Japan; and 10^{-6} n/sec at San Grasso. In summary: Both random and time-correlated emissions occur. There are low multiple counts. Bulk deuteration reduces large bursts. The physical mechanism is still not identified. Future experiments should use D-T gas loading. The measurement of the energy of the neutrons needs to be improved. Independent confirmation of various experiments is needed.

ILLINOIS - EXOTIC PLASMA MODEL

G.H. Miley, H.Hora (U of New So. Wales, Kensington, Australia), J.C. Kelly & B. Temple (Fusion Studies Lab, U. of Illinois except Hora), "Study of Cold Fusion at Interfaces", Presented at the Second Annual Conference on Cold Fusion, June 29-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

Based on the exotic plasma model for deuterons in Ti, Pd, Th, Fe, and other host metals with high incorporation of hydrogen, and on the resulting rare but quite possible short distances between nuclei, we previously derived necessary conditions for cold fusion reactions [*Nuovo Cimento*, **12D,** 393 (1990)]. This concept includes a strong reduction of the repulsion of the nuclei by the degenerate background electron gas as well as by a "swimming" electron surface layer recently derived from a plasma model of surface tension [Hora et al., *Proc. Symposium on Cold Fusion, World Hydrogen Conf.*, Hawaii, July 1991, p 169.] In place of the conventional Gamow law, this model provides a semi-empirical power law for understanding nuclear reactions at rather large distances. Since the swimming electron layer only exists at clean surfaces and is strongly reduced by contamination by oxides, by adsorbed molecules, and by electrolytic processes (consistent with the observation that some electrodes show only small spots of intense beta decay), we propose the use of special interfaces, e.g., Ti-Fe and other combinations to obtain clean swimming electron layer conditions. This approach results in reduced potentials, but the expectation of clean, reproducible conditions has led to the design of unique experiments with a plasma focus. The experiments and initial results were reported.

CHINA - NEUTRONS FROM DISCHARGE DEVICE

O. Xing Rihong (Inst. of Southwest Nuclear Physics & Chem), Gao Guolong, Long, Huqing (Inst. of Material, China Academy of Engr Physics), "The Detection of Neutrons in Discharge Device with Palladium Electrode and Deuterium Gas", Presented at the Second Annual Conference on Cold Fusion, June 29-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

Stimulated by reports of Fleischmann and Pons and Jones et al. of cold fusion, we made d.c. discharge experiments in deuterium gas. Electrodes were made of palladium tube (cathode) and tungsten cylinder (anode). Average neutron yield 85000 n/s was detected during 45 minutes, the neutron energy was 2.2 Mev. Nowadays in the experiments of high voltage a.c. discharge between two Pd rods soaked with deuterium gas in a glass bulb, the energetic neutrons (>3 Mev) emission are intermittently detected. [The abstract copy was difficult to read and the spelling of author's names may not be correct.]

EDITOR'S COMMENTS

Experiment used 8-10 kV a.c. for 8 to 10 hours using a 2mm Pd foil weighing 11.1 gm. Background measurements were made over a 72 hour period. Neutrons were measured over 3 sigma above background after the discharge had stopped.

INDIA - (Paper not presented)

M. Srinivasan, A. Shyam, T.C. Kaushik, R.K. Rout, L.V. Kulkarni (Neutron Physics Div), M.S. Krishnan, S.K. Malhotra, V.G. Nagvenkar (Heavy Water Div. - all at BARC, Bombay, India) & P.K. Iyengar (Atomic Energy Commission), "Observation of Tritium in Gas/Plasma Loaded Titanium Samples", Abstract provided for the Second Annual Conference on Cold Fusion, June 29-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

The observation of significant neutron yield from gas loaded titanium samples at Frascati in April 1989 opened up an alternate pathway to the investigation of anomalous nuclear phenomena in deuterium/solid systems, complimenting the electrolytic approach. Since then at least six different groups have successfully measured burst neutron emission from deuterated titanium shavings following the Frascati methodology, the special feature of which was the use of liquid nitrogen to create repeated thermal cycles resulting in the production of non-equilibrium conditions in the deuterated samples. At Trombay several variations of the gas loading procedure have been investigated including induction heating of single machined titanium targets in a glass chamber as well as use of a plasma focus device for deuteriding its central titanium electrode. Stemming from earlier observations both at BARC and elsewhere that tritium yield is about 10^8 times higher than neutron output in cold fusion experiments, we have channeled our efforts to the search for tritium rather than neutrons. The presence of tritium in a variety of gas/plasma loaded titanium samples has been established successfully through a direct measurement of the radiations emitted as a result of tritium decay, in contradistinction to other groups who have looked for tritium in the extracted gases. In some samples we have thus observed tritium levels of over 10 MBq with a corresponding (t/d) ratio of > 10^{-5}. One of the most interesting findings to emerge out of the autoradiographic imaging of deuterated Ti samples from different experiments is the fact that tritium is invariably concentrated in highly localized spots (fraction of an mm or less in size) each containing typically about 10^{12} to 10^{14} atoms (2 to 200 K Bq) of tritium. If this is viewed in the light of the observations of other groups, notably the Los Alamos work, that neutrons are produced in bunches of 30 to 300 within time spans of microseconds and also that the neutron-to-tritium yield ratio is in the range of 10^{-8} to 10^{-9}, it is tempting to speculate that in these titanium samples perhaps some kind of a cascade reaction or micronuclear explosion probably occurs in specific sites in the near surface region resulting in 10^{10} to 10^{12} fusion reactions during each event. This intriguing possibility warrants further experimental study.

JAPAN - D_2 GAS DISCHARGE & NEUTRONS

T. Tazima, K. Isii, & H. Ikegami (Nat'l Inst for Fusion Science, Nagoya, Japan), "Time-Correlated Neutron Detection from Deuterium Loaded Palladium", Presented at the Second Annual Conference on Cold Fusion, June 29-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

Neutron emission were detected from two kinds of deuterated palladium. One is two palladium rods of 2 mm diameter and 5 cm long, deuterated under 1 atm. The neutron emission was triggered by D_2 gas discharge heating between the two palladium rods facing each other as electrodes. The other is palladium shavings of 10.64 g (1 mole) baked at 200 C for 2 hours and contacted with deuterium gas of 11 atm for 2 weeks. The neutron emission in the latter case was observed after several trials of thermal cycles. The neutron detection consisted of two independent systems employing ^{3}He tubes with an efficiency of approximately 1% when calibrated by ^{252}Cf. The pulse height windows were set at best to eliminate

spurious signals. The dwell time was 100 sec in most of the cases. The averaged background level is 0.07 neutron/sec, and no kinds of sporadic bursts have ever been observed during the past 14 months or so. In both cases, following the triggering procedures, significant neutron emissions of successive bursts of 30-60 neutrons/dwell time were observed for several hours and repeated 4 times during 5 days in some cases. Those neutron bursts are reasonably time correlated between the two independent detection systems, so that it is hardly conceivable that those signals were originated from some spurious sources.

EDITOR'S COMMENTS

The first group of neutrons were recorded two days after discharge and for 3 times in eleven days. Definitely shows cold fusion. The T/n ratio not determined. Pd shavings were used (10 grams) and exposed to D_2 gas for 40 days at 11 atm. Neutron bursts occur during evacuation. Large bursts of neutrons were seen. The mechanism is still not understood. Cold working of the Pd may be a key parameter.

CHINA - 2 PAPERS ON USING CR-39

Ke L. Wang, Shi Y. Dong, Yu Y. Fen, Shi C. Wang, Yong F. Zhu, Ping L. Zhou, Min Y. Yao, Da W. Mo, Qin R. Lin, Xian F. Men, Lee Chang, Cheng M. Luo, Xing Z. Li (Tsinghua U, Beijing except Shi C. Wang - Inst. of High Energy Physics, Beijing, China), "Search for the Better Material for Cold Fusion Using CR-39", Presented at the Second Annual Conference on Cold Fusion, June 29-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

CR-39 (plastic track detector) has been proven to be a good detector in the research on cold fusion phenomena. It has high sensitivity and high efficiency in detection of energetic charged products of anomalous nuclear reactions. It does not need a high voltage power supply; hence, it is easy to use in the high pressure vessel of gas-loading experiments (Frascati type), and to eliminate the electronic noises. It has low background because the spurious signals due to cosmic ray can be discriminated by re-etching procedures. It can be run in batch and it is relatively cheap as well. Therefore, CR-39 technique is selected for wide-searching the better material for cold fusion. Different materials such as palladium from USA, Russia, and from different sources in China; pure titanium (in porous state), titanium alloys (e.g. V6-A16-Sn2); zirconium; nickel; lanthanum; and hydrogen-storage materials (such as $LaNi_5$) are tested using CR-39. Preliminary results show that: (1) Russian palladium imported in 1950's gives the highest yield of charged particles (> 100 per sq cm per day). The Ti alloy (Ti-662) is not as good as Russian palladium (about 100 per sq cm per day), but it still has high repetition rate. Other materials give no evident signal distinct from background, which is less than 10 per sq cm per day. The yield becomes less and less after the first usage in the gas-loading experiment. (2) It is important to eliminate the contamination of the surface of the materials due to the radioactive impurities (e.g. uranium 238, radon's daughter, et al.). However, it is possible to distinguish the real signal from the spurious by the shape of track in the microscopy [of CR-39.] (3) Using vapor deposit technique to plate the Russian palladium on another surface did not give positive results. (4) Auger electron scanning probe reveals the complicated surface composition at various points on the palladium foil, although it is pure palladium inside the materials. This may explain the difficulty in reproducing the cold fusion phenomena. [May have some errors - copy quality of abstract was poor.]

Shi C. Wang (Inst. of High Energy Physics), Ke L. Wang, Shi Y. Dong, Yu Y. Feng, Xing Z. Li (Tsinghua Univ., Beijing, China), "Identification of the Energetic Charged Particles in Gas-Loading Experiment of Cold Fusion Using CR-39 Plastic Track Detector", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

CR-39 plastic track detectors have been used for searching for charged particles from deuterized palladium and titanium foils. Alpha particles, slowed to various energies from a Cf source were used for the calibration. Since high-pressure deuterium gas (up to 58 atm.) and low temperature (down to 77 K) may affect response of CR-39, the calibration was done in the condition which mimics experimental condition as closely as possible. Our results show that pre- and post-irradiation high-pressure deuterium gas and low temperature do not make significant difference of response of CR-39. A calibration curve was obtained, using a 'restricted energy loss model' of track formation, the etching behaviors of 3.22 MeV proton, 1.01 MeV triton, and 0.82 MeV helium-3 were predicted.

EDITOR'S COMMENTS

Although Chinese work has suffered from an unexplained year-long reduction in effort, there is now considerable activity using some new approaches. In particular, Chinese experimenters have shown that the CR-39 plastic track detectors has some merit in measuring a variety of nuclear by-products of cold fusion. *Fusion Facts* will be printing more information about the source and use of CR-39. We expect that this will enable many colleges and high schools to perform experiments in cold fusion.

THEORY PAPERS (16 Abstracts submitted)

Summary: 16 abstracts on theory were submitted and printed in program material handed out at the conference. Eight of these papers were presented and three others participated at the Poster Session.

HAWAII - ELECTRON CAPTURE MODEL (Poster Session Presentation)

George Andermann (Dept of Chem, U. of Hawaii), "Theoretical Aspects of the Spectroscopic Consequences of the Electron Capture Model in Cold Fusion", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

While electron capture (EC) has been proposed as a plausible mechanism for the creation of neutral particles in D loading of Pd, the theoretical aspects of the spectroscopic consequences of the above EC models have received scant attention. This treatment covers two such aspects, namely, UV-visible and X-ray radiation. The UV-visible spectroscopic consequence are considered under the Koopman approximation, i.e., via the use of the frozen orbital model. It is shown qualitatively that for both the PdD and PdD_2 valence electron structures EC caused vacancies have sufficiently long lifetimes to allow UV-visible radiation to take place. It is proposed that under favorable experimental circumstances EC vacancies may be accompanied by a form of collective valence electron transitions which may be described as a sudden decay of valence electron excitons. While it can be shown that there may be a number of causes for X-ray radiation, this treatment concentrates on the consequences of the lifetime of two kinds of species caused by EC. Continuum soft X-ray emission is rationalized primarily by the EC caused transient species involving D. Characteristic X-rays of higher energy are assigned to EC caused transitions involving Pd and Rh.

ENGLAND - THEORY & PATENT IMPLICATIONS

Harold Aspden (Dept of EE, U of Southampton), "Cold Fusion: Theoretical Aspects and the Patent Implications", Abstract provided for Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

Until the truths of the cold fusion process are established in a way which enables us to design commercially useful reactors, we must interpret every clue with care and avoid bias which discounts the unorthodox. Furthermore, since this is not just an academic scientific curiosity but is a lifeline which can rescue us from our future energy problems, the patents arena and its bearing upon the research investment should have some influence on our research priorities.

Both of these topics are addressed by concentrating, not on the conventional approach to nuclear problems nor the chemistry of the subject, but rather on the electrodynamic actions which put constraints on the design of cold fusion reactors and the apparatus features that justify patent cover. The primary clues have to be the **apparent** facts, on this author's interpretation, that deuterons can fuse **cold** whereas protons cannot and that the anomalous heat generated exceeds that expected from deuteron fusion in terms of the resulting quantity of tritium by-product, the existence of which verifies that fusion has occurred.

Ignoring nuclear reaction theory, lattice structure properties and the chemistry of the deuteron absorption process, the relevant distinguishing factor between proton and deuteron is likely to be the **positive** character of the proton magnetic moment versus the **negative** character of the deuteron magnetic moment. This should suggest [1] that the deuteron is not a single entity of a closely knit quark group that has a positive charge, but rather a relatively loose composite of something that overall is positive but that has a core component accounting for its gyromagnetic reacting action that is negative, at least transiently. This gives scope for a transiently neutral combination in the ever-fluctuating exchanges that occur at the micro-nuclear level. Fusion under certain ion accelerating conditions involving deuterium nuclei stripped of their K-shell electrons, as in a palladium cathode, might seem possible during that neutral state, though not possible for protons.

Why then should it be possible to accelerate the deuteron ion in a palladium host, bearing in mind the ease with which electrons assume the role of charge transport? The answer to this may lie in existing research findings concerning anomalous enormously-high acceleration of heavy ions in gas discharges where electrons are present and the tremendous explosive forces indicative of anomalous heavy ion acceleration in water subjected to such rapid electrical discharge that ohmic heating has little consequence. This will be discussed by reference to the disclosures in [2-6] of the references. The findings imply that the design of the cold fusion reactor apparatus and its electrodynamic excitation are the key and that the apparatus as such, rather than the chemical nature of the system, should be the centre of concern in seeking patent protection.

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[6] "Heat generation by ion-accelerated energy transfer", UK Patent Applications No. 9,100,687 (12 January 1991).
See Also: "The No-Neutron Deuteron", *Fusion Facts*, Vol 1, No 9, pg 1 (March 1990).

ITALY - OVERSCREENING THEORY

Marcello Baldo (INFN, Catania, Italy), "Enhancement of fusion rate induced by the collective electron excitations", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHOR'S ABSTRACT

The anomalously large fusion rate of deuterium absorbed in transition metals, which has been claimed by some authors has produced a large amount of theoretical work. Legget and Baym have demonstrated that a rigorous upper bound to the fusion rate of deuterium, in equilibrium with the crystal, can be obtained in the framework of conventional solid state theory and using the phenomenological helium and deuterium chemical potentials. This bound is too small to be compatible with the claimed fusion rate. We explore the possibility that the interaction energy between helium atoms and the metal crystal possesses a second deeper minimum, which is separated by a potential barrier from the one accessible by the usual absorption experiments, but which can be more easily reached through the path followed by the deuteron-deuteron fusion process inside the crystal. The interaction of a bare positive charge with the electrons of the crystal is modeled in terms of its coupling with a set of harmonic oscillators, which describe the collective excitation of the electron gas. The energies of the latter can be obtained experimentally. Making use of the f-sum rule, evidences are presented which indicate the possibility of an 'overscreening' of the charge, a phenomenon that could render a configuration with delocalized electrons around the charge energetically favorable with respect to a helium-like configuration inside the crystal. Speculations about the possible connection with cold fusion are presented.

SWEDEN - HYDROGEN IN $Pd_{77}Ag_{23}$ ALLOY

R.V. Bucur (Inst of Chem, U of Uppsala, Sweden), "Interaction of Hydrogen with the Microstructure of Pd and $Pd_{77}Ag_{23}$", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHOR'S ABSTRACT

The strength of the interaction of H-atoms with the interstitial sites considerably depends on their environment. The disorder in the host lattice due either to a foreign substituent atom or to the microstructure may contribute to this alteration. The interstitial sites localized within the disturbed region induced by the microstructure act as traps for the H-atoms, but to a certain extent may be influenced by the nature and concentration of the substituent, as well. In this work data will be presented on the effect of the microstructure on the diffusivity and solubility of hydrogen in palladium and in the well known palladium-alloy $Pd_{77}Ag_{23}$. The microstructure has been changed either by mechanical processing (Pd & $Pd_{77}Ag_{23}$) or by alpha/beta and beta/alpha phase transitions (Pd) and the measurements have been carried out by electrochemical transient techniques. The results, discussed within the two-state model, **suggest that the energy of the normal interstitial sites is considerably effected by the defect concentration in Pd while it is independent on that in $Pd_{77}Ag_{23}$.**

EDITOR'S COMMENTS

Bucur states that in polycrystalline Pd there is hydrogen transport along grain boundaries, lateral leakage, and segregation at crystal dislocations. The conclusions were that there is fast hydrogen diffusion in grain boundaries and slow diffusion in the grain volumes. Neither the volume nor the grain boundary is affected by diffusion. The $Pd_{77}Ag_{23}$ does not seem to slow down the diffusion.

Note: Through the courteous help of the Johnson-Matthey New York office, we were able to talk to Dr. Jim Hunter, the scientist who did the original research work on the $Pd_{77}Ag_{23}$ alloy which is still the standard material sold for the extraction of hydrogen from gas mixtures. We will have an article about Dr. Hunter's work in the August 1991 issue of *Fusion Facts* and its implication for the future of cold fusion. Ed.

CALIFORNIA - MORE ABOUT THE TRM

Robert T. Bush (Cal State Polytech U, Pomona, CA), "The Transmission Resonance Model (TRM) for Cold Fusion Updated: Explication of Neutron Emission", Poster Presentation at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHOR'S ABSTRACT

The TRM is the only model at this stage to provide a good fit to nonlinear calorimetric data on the excess heat effect of Fleischmann and Pons [*Fusion Technology*, **19**, 313, March 1919.] Thus, it is of significance that a theoretical breakthrough now allows the model to account for data on the neutron emission component of cold fusion as observed, for example, in (1) gas-loading experiments of the type pioneered by Scaramuzzi of Frascati and refined by Menlove and Jones (USA), (2) electrolytic experiments (Jones, Wolf & others), and (3) ion implant experiments (Zelenskii, Soviet Union). This theoretical breakthrough should strengthen the suggestion that the TRM is on track to provide a unification of most, if not all, cold fusion phenomena.

EDITOR'S COMMENTS

Regardless of the lack of universal acceptance of Dr. Bush's TRM, the model is distinguished by being the current leading model in terms of the various cold fusion effects that have been predicted and measured. Dr. Bush assures us that he expects to explain further cold fusion phenomena.

VIRGINIA - LATTICE NUCLEAR CHEMISTRY
Two theory papers by Chubb and Chubb

Scott R. Chubb & Talbot A. Chubb (Research Systems, Arlington, VA), "An Explanation of Cold Fusion and Cold Fusion By-Products, Based on Lattice Induced Nuclear Chemistry", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

At room temperature, solid state effects may alter the framework from which nuclear processes proceed in a manner that is completely difference from the one responsible for nuclear interaction between free space deuterons. Quantum mechanical effects enter during the overcharging of a fully-loaded PdD lattice as a result of periodic order, the requirement that energy be minimized, and the fact that deuterons which share a common potential are indistinguishable and must be described by a single, many-particle wave function. When a macroscopically small number of deuterons are added to stoichiometric PdD, a compound can be created of the form $PdD_{1+DELTA}$, in which solid state physics effects provide a channel for reducing lattice strain by distributing the excess charge (delta) with equal weight to all periodically equivalent locations within the crystallite. Then, the fundamental free space idea that a huge Coulomb barrier must be overcome in order for D+D nuclear interaction to occur is replaced by a new picture in which small portions of each of the excess deuterons, on the average, are distributed throughout the solid, thereby avoiding the stress that results when two deuterons are forced into a common unit cell. Because only a small fraction of each excess deuteron is present at any site and each excess deuteron is indistinguishable from the others, it becomes possible for microscopically large numbers of pairs of excess deuterons to interact. This new form of nuclear interaction is not inhibited by proton-proton repulsion because when the excess charge (delta) is sufficiently small, the lattice provides the dominant electrostatic interaction. Lattice interaction further greatly reduces proton repulsion by inducing a broadening of proton charge. The lattice interaction is responsible for new selection rules in which the energy release is distributed among all unit cells. Release of high alpha energy particles at isolated sites is also allowed. We have previously named this new form of nuclear reaction, Lattice Induced Nuclear Chemistry (LINC). In LINC, the new selection rules allow deuterons to fuse to form ^4He throughout the crystal while maintaining periodic order. Energy release occurs by coupling to phonons or coherent motion (in which the lattice moves as a whole), accompanied by the expulsion of "untrapped", low-energy ^4He into the surface and outgassing regions. In this paper, the underlying assumptions responsible for LINC and the resulting selection rules will be summarized and explained. Comparisons will be made between predictions provided by LINC with recent experiments.

Talbot A. Chubb & Scott R. Chubb (Research Systems, Arlington, VA), "Cold Fusion and a Non-corpuscular View of Matter", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

It is interesting to speculate about the impact on physics that will occur if cold fusion becomes accepted as a real phenomenon. Cold fusion will be seen as a distributed interaction rather than an interaction at a point. It will be seen as an expression of the inseparability of particles from the space-time complex in which the particles have their existence. The quantum behavior of indistinguishable particles and the attributes distinguishing the different types of particles will be interpreted in terms of a microscale multidimensional fabric of which space-time is the macroscopic component. Physicists will have to accept the existence of a new form of matter, namely "ion band state" matter made up of atomic nuclei volumetrically distributed over a host lattice (ion Bloch states). This changed perspective will affect other branches of physics and astronomy.

EDITOR'S COMMENTS

The author's were kind enough to provide *Fusion Facts* with copies of their briefing slides. We will provide more detailed information about their theory in a subsequent issue. Chubb & Chubb's model suggests that silver will be useful to promote cold fusion! For some dramatic implications about the Coulomb barrier, see page 30 of this issue about "New Energy Source Patented."

MASS - MIT & HAGELSTEIN'S THEORY

Peter L. Hagelstein (MIT), "Coherent and Semi-coherent Neutron Transfer Reactions", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHOR'S ABSTRACT

During the past several years, we have developed a theory for coherent nuclear reactions which achieve an enhancement in reaction rate through collective effects. The theory has been applied successfully to coherent neutron transfer reactions, and leads to a model in which heat production and slow tritium production in deuterated Ti and Pd systems is predicted. Estimates for total reaction rates have been obtained which appear to be in agreement with reported Pons-Fleischmann heat levels. Neutron and fast tritium production arise in the theory from semi-coherent reactions, and fast particle energies appear to be consistent with reported observations.

EDITOR'S COMMENTS

Prof. Hagelstein's latest version of his developing model for cold fusion predicts heat, slow tritium, fast neutrons, and neutrons [thermal?]. *Fusion Facts* looks forward to the time when others at MIT discover cold fusion and that this prestigious university lends its talents to the development of this important new science.

SWEDEN - FUSION RATE IN THE TRM

Magnus Jandel (Dept of Theoretical Physics, Royal Inst of Tech, Sweden), "The Fusion Rate in the Transmission Resonance Model", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHOR'S ABSTRACT

A stream of particles incident on a pair of high and wide potential barriers can for certain energies be perfectly transmitted although a single barrier would almost completely reflect the incoming particles. This transmission resonance effect is a well known consequence of the wave nature of matter. Leaf Turner suggested that the transmission resonance effect could be related to cold fusion. Robert T. Bush has constructed an extensive phenomenological model based on the resonant transmission of mobile deuterons through a chain of Coulomb barriers provided by the fixed deuterons in a metal lattice. The circumstance that the deuteron current at resonance smoothly flows through the system has, however, not been clearly related to the absolute fusion rate. This paper is intended to give a quantitative description of the fusion rate under transmission resonance conditions. A soluble model is used to give a pedagogic demonstration of some generic features of transmission resonances such as the presence of metastable states and the detailed mechanism of barrier penetration. General theoretical results are discussed and applied to the cold fusion situation.

INDIANA - PURDUE - SHOCK-WAVE MODEL

Two Abstracts were submitted.

Yeong E. Kim (Dept of Physics, Purdue) & Mario Rabinowitz (EPRI, Palo Alto, CA), "Non-Equilibrium Acceleration Mechanisms for Deuterium Ions in Electrolysis and Gas/Metal Fusion Experiments", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

We describe various acceleration mechanisms for deuterium ions that are needed to explain the results of electrolysis and gas/metal fusion experiments in terms of a non-equilibrium surface fusion mechanism. The mechanisms involve accelerations of D_2O^+, D_2^+, and D^+ ions due to Rutherford double back-scattering and knockon followed by double back-scattering (triple scattering). Possibility of shock-wave heating is also considered. Calculated nuclear fusion rates due to energy-enhanced deuterium ions will be compared with the results of electrolysis and gas/metal fusion experiments.

Yeong E. Kim (Dept of Physics, Purdue), Mario Rabinowitz (EPRI, Palo Alto, CA), G.S. Chulick, & R.A. Rice (Physics, Purdue), "Shock-Wave Model for Cluster-Impact Fusion", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

A theoretical model for cluster-impact fusion based on a shock-wave impact-fusion mechanism is described. We show that shock waves can be generated by clusters and that associated energy loss mechanisms have negligible effects. This model can explain the existing data from

recent cluster impact fusion experiments and is used to predict D-D and D-T fusion rates for future experiments. Also, it is shown theoretically that it is highly unlikely that the cluster-impact fusion data can be explained on the basis of artifacts such as light ionic contamination.

MARYLAND - NAVY THEORY ON Pd DENSITY

Hans S. Uhm & W.M. Lee (Naval Surface Warfare Center, Silver Spring, MD), "High Concentration of Deuterium in Palladium", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

Based on a theoretical calculation, a new scheme to increase deuterium density in palladium over its initial value is presented. High deuterium concentration in palladium is needed for application to the solid-state fusion, where nuclear fusion between deuterium atoms may take place in ambient-temperature palladium after being loaded with the atoms. When the atomic ratio (gamma) of deuterium to palladium (gamma = deuterium/palladium atoms) is considerably higher than unity, a substantial fraction of the bulk palladium is transformed into the PdD_2 crystal, where the nearest-neighbor distance between deuterium atoms is d = 0.94 angstroms. **Schwinger developed a theoretical model, where the electromagnetic selection rules suppress radiation, permitting excess energy transference to the lattice, and where the coherent nature of the wave-function plays a key role in enhancing fusion probability.** His discussion is restricted to tritium production based on the D-D reaction that populates the first excited state of ^4He. According to his estimation, tritium production rate is in a measurable range for a reasonable size of the PdD_2 crystal. In this regard, we propose two schemes to increase considerably the deuterium density inside a palladium sample. The first deuterium enrichment scheme makes use of the plasma ion implantation, which consists of a cylindrical palladium rod (target) preloaded with deuterium atoms, coated with diffusion-barrier material and immersed in a deuterium plasma. The palladium rod is connected to a high-power modulator, which provides a series of negative-voltage pulses. During these negative pulses, deuterium ions fall into the target, penetrate the diffusion barrier and are implanted inside the palladium. For reasonable system parameters allowed by present technology, we find from theoretical calculations that the saturation deuterium density after a prolonged ion implantation can be several times of the palladium atomic number density.

The second deuterium enrichment scheme makes use of the temperature gradient effects on the deuterium solubility in palladium. A heat source at temperature T_2 and heat sink at temperature T_1 (where $T_2 > T_1$) are in contact with two different parts of a palladium sample, which has been presoaked with deuterium atoms and has been coated with diffusion -barrier material or securely locked in a metal case. A temperature gradient created in the sample from such arrangement forces the deuterium atoms in the hot region to migrate into the cold region, resulting in higher deuterium density in the cold region. A theoretical model of deuterium migration in palladium is based on the fact that the deuterium solubility is a decreasing function of temperature and that total number of deuterium atoms in the palladium sample is conserved. This scheme is particularly advantageous over other methods in compressing deuterium density in a small region because a wide range of temperature window can be applicable to the palladium sample.

EDITOR'S COMMENTS

Those who have carefully read Dr. Schwinger's paper should also consider some modifications made to this paper by Dr. Robert Bass. It is believed that Dr. Bass's additions to the Schwinger work will lead to a better understanding of the physics of cold fusion.

INSTRUMENTAL PAPERS
6 Abstracts Submitted

ILLINOIS - IMPROVED CALORIMETER

Thomas F. Droege & Lee John Droege (Batavia, IL), "An Improved Zero Gradient Calorimeter for the Investigation of Cold Fusion Phenomena", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy. [Paper presented by Dr. Tibbals.]

AUTHORS' ABSTRACT

As in the earlier design [Droege & Droege, *Proc. of the First Annual Conference on Cold Fusion*], this calorimeter utilizes an inner and outer shell which are held at the same constant temperature by servo controlled thermoelectric devices. A two-liter Dewar now houses the test cell. Machined heat shells provide uniform heat distribution. A thermoelectric device is now used as a high precision null sensor between the two shells. Additional layers of insulation and servo controlled heat shields have reduced heat leaks. The machined assembly now allows dismounting to change experiments without change in calibration constants. Long term calorimeter drifts of 1 mW and less have been achieved when operated at 10 watts. For the partial calibration run (see Figure in paper), the calorimeter contains a Pt-Pd cell with a catalyst operated reversed with the Pd as the

anode. Calibration is thus at the same heat levels and with the heat generated in the same locations as later forward runs searching for cold fusion. This run was made at 50 ma per sq cm, 1 watt cell power, 6.6 watts balancing heater power and 7.6 watts of refrigeration. The first ten hours test the calorimeter drift. Then, starting with hour ten and at one hour intervals, calibration impulses of 5, 10, 20, 40, and 80 Joules are applied through a separate heater not in the computer energy balance. This tests the calorimeter sensitivity. The paper discusses details of fabrication and calibration and presents preliminary data runs.

EDITOR'S COMMENTS

Comments made at the conference from correspondence by Droege resulted in a letter to the editor which is printed in this issue. Please read Droege's letter.

SPAIN - PHASE TRANSITION IN Ti

F. Fernandez, B. Escarpizo, J. Sevilla, J. Tornero, F.Cuevas & C. Sanchez (Dept of Applied Physics, U. Autonoma de Madrid), "Solid State and Electrochemical Phenomena Related to Cold Fusion in Titanium", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

Although we have obtained positive results in some of our cold fusion experiments, we have not yet been able to reproduce them. This irreproducibility is probably related to some non-well-known characteristics of the metal-hydride system. During the last year we have investigated some of those characteristics and now we present new results on two of them: the improvement of the charging of Ti cathode with deuterium by surface and bulk treatments and the non-equilibrium in the formed deuteride. It has been pointed out by other authors that a heavy deuteration of the metal is necessary if cold fusion is to be produced. Furthermore, it is known that permeation of deuterium in Ti by electrochemical means does not go further than a few microns. We feel in agreement with Brauer et al. that a deeper penetration of deuterium is limited by grain boundaries that behave as diffusion barriers. We, therefore, have tried to improve deuteration of titanium in two ways: by reducing the grain boundaries density or increasing the size of the grains in the metal and trying to produce oxygen and nitrogen-free titanium. Commercial titanium has an average grain size of 10 micrometers. Through several thermal treatments the grain size has been increased by an order of magnitude. Results will be presented on the effects of these thermal treatments on the titanium deuteration. Surface effects on the deuteration process have been studied by cyclovoltammetry (CV). Several etching treatments have been tried and their influence on the CV of titanium in acid and basic media studies mainly in order to characterize the adsorbed and absorbed D_2 (H_2). Finally, we have deeply investigated the tetragonal-cubic phase transition of TiH_X as a non-equilibrium situation that could ignite cold fusion reactions. By using differential scanning calorimetry (DSC) and X-ray diffraction **we have concluded that in electrolytically and in pressurized-gas-deuterated titanium the phase transition is not reproducible even with very high deuterium concentration (TiD_X, $x > 1.7$).** We have analyzed several factors related to the metal quality and the experimental procedure followed to deuterate it which could avoid the appearance of that phase transition. Finally we consider the possible influence of this behavior on cold fusion experiments.

[Note: Dr. Sanchez ended his presentation with the following question: "By the Way: How many other non-reproducible effects will the Ti have?]

ITALY - DOUBLE-SCATTERING N DETECTOR

M. Agnello, T. Bressani, D. Calvo, A. Feliciello, P. Gianotti, F. Iazzi, & B. Minetti (INFN Sezione di Torino, Italy), "Performances of a Neutron Detector Based on Double Scattering", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

The performances of a detector designed for measuring the energy of neutrons emitted from Cold Fusion apparatus and built in the INFN Laboratories of Turin, Italy are reported: it is based on the neutron double scattering in two different scintillator arrays by means of which the position of the first and second scattering of the neutron on both scintillators together with the time spent between both scatterings can be measured. Through the kinematical relationships the energy of the neutron as emitted from the source is obtained. The performances of this detector have been evaluated by applying the energy reconstruction procedure to a Monte Carlo sample of data simulated taking into account the time and position experimental incertitude (typically +/- 1 ns and +/- 4.5 cm.): the reconstructed energy resolution is about +/- 300 keV for neutrons of 2.4 MeV. A second instrumental test has been performed, based on the measurement of the energy of neutrons emitted from an Am-Be source in coincidence with a gamma: the gamma was detected by a small scintillator near the source and this signal was used as start for the measurement of the neutron time of flights from the source to the first array; in this way the neutron energy as emitted was measured

and compared with the reconstructed one. Through this technique the previous result has been confirmed.

SWEDEN - MULTIPARAMETER NEUTRON DATA

Anders, Sjoland, Per Kristiansson, Johny Westergard & Klas Malmquist (Dept of Physics, Lund Inst. of Tech, Sweden),

AUTHORS' ABSTRACT

We have designed a detector system especially suitable for the detection of neutrons from cold fusion and performed some initial experiments with Ti/D_2-cells. The detector system is based on the liquid scintillator NE-213, which gives a good detection efficiency and the possibility to perform pulse shape analysis. The detector has the shape of a horizontal cylinder with a central well for the cells. There is one viewing window on each side with light guides and PMTs mounted. During the experiments we used a complex circuit of discrete nuclear electronic units to perform the analysis and computer system to store the data event by event. We thus obtained a good separation between gamma and neutrons down to a neutron energy of 0.8 MeV. The cosmic background was monitored by "veto plates", thereby decreasing the cosmic background by approximately 90 percent. A gamma ray detector was also used to monitor the overall gamma ray background. In the experiments titanium shavings were exposed to deuterium gas under high pressure in a small vessel. The vessel was immersed into liquid nitrogen and then insulated and placed in the well of the detector. The temperature and the pressure of the gas were continuously monitored. During the experiments some parameters were varied. Pure titanium and the titanium alloy Ti-662 were used and treated in different ways. Between the different runs of the experiments background measurements and calibration with gamma ray and neutron sources were performed to serve as references and stability checks. We also performed experiments with hydrogen instead of deuterium. Using an electrostatic accelerator neutrons were produced for energy calibration of the detector. The smallest fusion rate that can be detected by the system is estimated to about 10^{-8} fusions per second per deuteron pair.

ITALY - SOLID ANGLE NEUTRON DETECTOR

G. Ricco, M. Anghinolfi, P. Corvisiero, P. Prati, C. Salvo, M. Taiuti, C. Boragno, R. Eggenhoffner, U. Valbusa (Dept. of Physics, Sezione di Genova, Italy), "A Large Solid Angle Multiparameter Neutron Detector", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

A 4 pi neutron detector has been realized using organic scintillators: the detector is suitable for high efficiency, low background measurements of very low neutron rates in the 0.6 to 5 MeV energy range. Gamma-neutron discrimination has been performed by pulse shape, energy and neutron life-time analysis, and backgrounds have been reduced by anticoincidence detectors and paraffin-lead shielding. Tests of efficiency, energy resolution, and radiation identification have been made with a low intensity Am-Be neutron source. The correlation between pulse height and width, shown in figures given in the paper, for a ^{60}Co and a Am-Be source, allows a good gamma-neutron discrimination.

CHINA - MEASURING NEUTRON BURSTS

Zhu Rongbao, Wang Xiaozhong, Lu Feng, Ding Dazhao, He Jianyu, Liu Hengjun, Jiang Jincai, Chen Guoan, Yuan Yuan, Yang Liucheng, Chen Zhonglin (China Institute of Atomic Energy, Beijing), "Neutron Burst Determination of Gas-Metal System and Computerized Time Distribution Retrieval System for Burst Detection", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

TA1 plate, Ti/Nb alloy rod, and 662 alloy rod were used as titanium metal raw materials and undergone different kinds of cold work before lathing, drilling, and plating to increase the densities of crystal defect and dislocation. In latest experiment this year, the neutron bursts occurred during the warm-up period of liquid nitrogen temperature cycles, with neutron number up to 560 in one group. The experiments of detector cooling were performed with enough cold empty bottles filled to the well of the HLNCC neutron detector to demonstrate whether the neutron burst determination would be affected by the moisture problem of the high voltage conjunction box. A liquid scintillation fast neutron detector was inserted into the well of the HLNCC device with 18 ^3He thermal neutron counters to form a multi-detector system with different detection principles. The AST-286 computer was employed to retrieve all the time labeled pulses of the ^3He counters within a time interval of 128 microsec starting from arrival of the trigger pulse of fast neutron detector to examine the die-away behavior of neutron bursts for the purpose of distinguishing the neutron signals from electronic noise.

UTAH - TRITIUM ANALYSIS PROCEDURE

K. Cedzynska & F.G. Will (NCFI), "Analysis of Tritium in Palladium Before and After Deuterium Loading", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

A closed-system analytical procedure was developed and applied in the determination of tritium in palladium samples from various suppliers, both as-manufactured and used in deuterium loading experiments. This procedure involves the dissolution of palladium in acid with the simultaneous formation of deuterium and tritium gas. A distillation and gas recombination method is employed to result in tritiated water which can be readily handled in the subsequent analytical procedure. The tritiated water is analyzed in a liquid scintillation counting (LSC) system, avoiding the usual LSC problems of color-quenching and chemiluminescence. The closed-system analysis techniques was applied to the determination of tritium in palladium which was loaded with deuterium either electrolytically or by the Wada-type gas loading method. The electrochemical experiments, tritium levels as high as ten times above background were detected in palladium cathodes. In several gas phase loading experiments, tritium enhancements in the palladium of up to 25 times background have been observed.

EDITOR'S COMMENTS

The advances made by scientists of the National Cold Fusion Institute (NCFI) in tritium measurement should lead to a greater interest in monitoring tritium, especially in view of the fact that cold fusion appears to produce tritium from 10^4 to 10^9 times as often as the production of neutrons. ***Fusion Facts*** **would welcome contributions about on-line real-time tritium measurements.**

OTHER ITEMS RELATED TO COLD FUSION (12 Abstracts Submitted)

COLORADO - MEASURING VERY LOW ENERGY

F.E. Cecil & J.A. McNeil (Colo School of Mines), G.M. Hale (Los Alamos Nat'l Lab), "Measurement of D-D and D-^{6}Li Nuclear Reactions at Very Low Energies, Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

We have completed a series of cross-section measurements of the D-D and D-^{6}Li reactions at center-of-mass energies between 170 and 2 keV. The reactions which have been considered, all potentially with application to cold-fusion phenomenon, specifically are D(d,p)T, D(d,n)^{3}He, D(d,gamma)^{4}He,D(^{6}Li,p)^{7}Li, D(^{6}Li,alpha)^{4}He, and D(^{6}Li,gamma)^{8}Be. The results of these measurements will be presented and compared to R-matrix calculations. In addition the data will be evaluated for possible evidence for an Oppenheimer-Phillips type enhancement of the (d,p) branches of these reactions and for a general enhancement at the very lowest energies resulting from projectile-target electron screening. The role of these reactions in the diagnostics of cold-fusion experiments will likewise be addressed. The D-D reactions in particular were studied using the CD_2 and Ti-D targets and any possible dependence of the reaction yield on the target matrix will be evaluated.

HUNGARY - MOSSBAUER SPECTROSCOPY

E. Kuzmann & M. Gal (Eotvos Univ., Budapest, Hungary), "Mossbauer Spectroscopic Characterization of Samples for Cold Fusion Experiment", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

In our previous works Mossbauer spectroscopy (as well as neutron and gamma-spectroscopy) was used to study the possibility of cold nuclear fusion in Fe-Zr amorphous alloys deuterized electrolytically both in air and in nitrogen atmosphere. Electrical monopole and quadrupole as well as magnetic dipole interactions measured by Mossbauer spectroscopy can provide information about the surrounding of Mossbauer atoms in deuterized samples. Consequently, the localization of deuterium can be sensitively studied. Mossbauer spectroscopy can be especially advantageously applied to the study of the effect of electrolytical hydrogenation of Fe-Zr amorphous alloys because the considerable changes appearing in the spectra (due to the change in the deuterium concentration or due to small heat effects) allow us to detect any structural changes caused by deuterization. Because Celani et al. have shown neutron burst activity in deuterized high T_C superconductor, we have prepared $EuBa_2(Cu_{1-X}{}^{57}Fe_X)_3O_{7-DELTA}$ high T_C superconductors for cold fusion experiments to be performed in an international collaboration. Both the Cu(1) and Cu(2) as well as the rare earth sites can be sensitively monitored by the Mossbauer measurements. The preliminary results of ^{151}Eu and ^{57}Fe Mossbauer investigation of these samples will be discussed.

EDITOR'S COMMENTS

It is our understanding the results of this experimental work will be published in the April-June 1991 issue(s) of *Nuclear Tech. in Nucl. Structures.*

CALIFORNIA - NAVY - Pd ELECTRODEPOSITION

S. Szpak & P.A. Mosler-Boss (NOSC, San Diego, CA) & J.J. Smith (DoE, Washington, D.C.), "Reliable Procedure for the Initiation of the Fleischmann-Pons Effect", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

Statistics on the initiation of the Fleischmann-Pons effect are rather poor. Reports presented at The First Annual Conference on Cold Fusion have indicated that, at best, only about 1 out of 10 attempts were successful in either producing excess enthalpy or yielding products associated with nuclear reaction(s). Recently, [S. Szpak et al., *J. Electroanal Chem*, **302**, 255 (1991)] we have shown that the Fleischmann-Pons effect can be reproducibly and rapidly initiated by employing Pd electrodes prepared by the electrodeposition from Pd^{2+} salts in the presence of evolving deuterium. The effectiveness of this procedure is examined in terms of tritium production. Effects of deposit morphology, electrolyte composition and temperature on the rate of tritium production are discussed.

EDITOR'S COMMENTS

The authors showed how they had found tritium enrichment starting about eight hours after beginning their experiments. In a previous paper [Tian et al., *Fusion Facts*. November 1990, page 44] Szpak's plating technique was tried at the National Cold Fusion Institute with modest results found in the increase in tritium production. Szpak mentioned that the reproducibility, in obtaining measurement of X-Rays resulted in some successes, some failures. John Bockris remarked that this approach [if replicable] is a remarkable and valuable contribution. See also Dr. R.T. Bush's report in this issue where Pd plating on Ag has shown excellent results in a cold fusion cell.

ITALY - CROSS SECTION FACTORS

A. Scalia (Dipart. di Fisica, Univ di Catania, Corso, Italy) & P. Figuera (Lab Nazionale del Sud, Doria, Italy), "The Cross Section Factor for the Reactions $^2H(d,p)^3H$ and $^2H(d,n)^3He$ at Very Low Energy", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHORS' ABSTRACT

The fusion cross section is obtained in terms of the Rutherford scattering by assuming that the fusion process is the "shadow" of elastic scattering. [A. Scalia, "The sub-barrier fusion as the shadow of the elastic scattering" to be publ. in *Il Nuovo Cimento*. See also *Nuovo Cimento*, **103,** 85,213,255,927,1177 (1990).] The parameters which appear in the analytical expression of fusion cross section are determined by fitting the experimental values of fusion cross section. The cross section factor, <sigma nu> is obtained by using this fusion cross section and by assuming that the distribution of relative velocity between two different sets of particles will be described by Maxwell-Boltzmann distribution. The values of <sigma nu> at different temperatures are determined by performing numerical integrations. At energies at which the experimental data are available the values of cross section factor obtained coincide with those reported in the literature, at very low energies experimental data are not available and our approach is able to give the values of cross section factor. At T = 300 K, we obtain:

N_A <sigma nu> = 3.5286×10^{-27} (cu cm per mole per sec.)

ITALY - ALPHA-EXTENDED MODEL

Roberto A. Monti (Consiglio Nazionale Delle Richerche, Bologna, Italy), "Cold Fusion and Cold Fission: Experimental Evidence for the Alpha-Extended Model of the Atom", Presented at Second Annual Conference on Cold Fusion, June 30-July 4, 1991, Como, Italy.

AUTHOR'S SUMMARY

Part I: A new model of the atom.
On the basis of Thomson's, Parson's, Lewis', Allen's, and Harkins' hypotheses a new model of the atom is advanced, characterized by the following features: 1) substantial asymmetry of the Coulomb electric and magnetic fields of electrons and protons; 2) existence of positions of stable electromagnetic equilibrium of electrons in the vicinity of nuclei; 3) the neutron is a particular "bound state" of the hydrogen atom; 4) the nuclei, whose dimensions are greater than supposed by Rutherford are composite structures of hydrogen atoms, of period 4 (Alpha-extended model); 5) Physical and chemical properties of each atom depend on the various, possible, isomeric configurations. In the light of this new model, The Periodic Table of the Elements has been reconstructed.

Part II: Experimental evidence for the Alpha-extended Model.
The genesis of the elements and the Alpha-extended model of the atom are shown by means of: 1) neutron synthesis, starting from a cold plasma of protons and electrons; 2) the synthesis of deuterium, tritium, helium-3, and helium-4, starting from hydrogen, ultra cold neutrons and thermal neutrons; 3) the production and

decay of Helium-8; 4) the production and decay of the nuclei from 11 alpha to 18 alpha; 5) "cold fusion" of Iron-56; 6) cold fission; 7) carbon isomeric configurations (allotropic forms); 8) cold fusion in metal lattices; 9) biological cold fusions and cold fissions (weak energy transmutations); and 10) the distribution of the scattered radiation.

C. NEWS FROM THE U.S.

NEW ENERGY SOURCE PATENTED
Courtesy of Dr. Samuel P. Faile

United States Patent Number: 5,018,180
Title: Energy Conversion Using High Charge Density.
Inventor: Kenneth R. Shoulders, Austin, Texas.

INVENTION ABSTRACT

Disclosed are apparatus and method for obtaining energy from high electrical charge density entities. The energy may be received by the conductor of a traveling wave device positioned along the path which the propagating entities follow. Multiple traveling wave devices may be combined. Energy output from a traveling wave device may also be directed to the generation of a subsequent such entity. Thermal energy may also be obtained from an EV.

EDITORS' COMMENTS

On page 68 and 69 of the patent "Energy Converters" are discussed as an embodiment of the invention. The following comment is made: "With the input pulse length reduced to 5 ns, for example, the corrected energy conversion factor becomes (16/5)/30 = 96 [sic, it should be x 30]. That is to say, with the input pulse length reduced as noted, energy available at the output of the helix of the traveling wave tube is ninety-six times the energy input to the traveling wave tube, in addition to the energy consumed within the traveling wave tube and the energy available in the form of collected particles at the collector electrode. ... The EV is a mechanism for tapping a source of energy and providing that energy for conversion to usable electrical form. ... In any event, energy is provided to the traveling wave output conductor, and the **ultimate source of this energy appears to be the zero-point radiation of the vacuum continuum."**

It is important to note that Ken Shoulders is working closely with H. E. Puthoff (Institute for Advanced Studies at Austin). As an example of Puthoff's work see "Gravity as a zero-point-fluctuation force", *Physical Review A*, Vol 39, No 5, pp 2333-2342, March 1, 1989. Shoulders and Puthoff have been working on the creation and use of "electron beads" [S.P. Faile, "Zero-Point Energy and Possible Applications to Cold Fusion", *Fusion Facts*, Vol 2, No. 8, pp 17-18, February 1991.] The electron beads consist of 10^9 to 10^{11} electrons similar to a miniature ball lightning. The patent discloses how to create and control such electron beads. As with cold fusion, these electrons beads seem to defy the Coulomb barrier. If 10^9 electrons can be kept in a micron-sized entity, it would appear that two deuterons may be able to get together to fuze.

It is my opinion that this is the most important patent to issue within the last decade (because no cold fusion patents have yet issued). It is my scientific judgement that the mechanism (as yet not fully understood) by which electron beads can be produced will be useful in the understanding and development of cold fusion. We will have more information about this development in the next issue of *Fusion Facts.*

I believe it was Freud that made much of "synchronicity". It is interesting that Shoulders & Puthoff, Fleischmann & Pons, and Randall L. Mills should all discover excess energy devices within such a short time period. Are there some others out there? Hal Fox, Ed.

D. NEWS FROM ABROAD

ITALY - SUPERFLUIDITY OF ^{4}He

Emilio Del Guidice (INFN, Milano), Matteo Giuffrida, Renata Mele, & Giuliano Preparata (Dept. Fisica, U. di Milano), "Superfluidity of ^{4}He", *Physical Review B*, Vol 43, No 7, (1 Mar 1991), pp 5381-88, 20 refs.

AUTHORS' ABSTRACT

We apply the recently proposed approach of quantum field theory of superradiance to liquid ^{4}He. We find natural, and input-free, explanations of (i) the temperature dependence of the roton gap delta(T) and the normal-fluid fraction p_N/p, (ii) the microscopic two-fluid structure of superfluid ^{4}He; and (iii) the basic mechanism of vortex formation and the associated critical velocities.

EDITOR'S COMMENTS

In the introduction, the author's state, "Quantum field theory (QFT) is the natural theoretical framework for dealing with quantum-mechanical systems comprising a very large (infinite in the limit) number of dynamical degrees of freedom, such as those occurring in condensed matter." The potential value of the QFT approach in creating a better understanding of cold fusion phenomena is the reason that we have included this non-cold fusion article.

SEE ALSO A SIMILAR PAPER:

Emilio Del Guidice (INFN, Milano), Matteo Giuffrida, Renata Mele, & Giuliano Preparata (Dept. Fisica, U. di Milano), "Superradiance and Superfluidity in ^{4}He", *Europhysics Letters*, Vol 14, No 5, (1 Mar 1991), pp 463-468.

POLAND & ITALY - CO AS A Pd POISON

A. Czerwinski (Warsaw U.), S. Zamponi & R. Marassi (U di Camerino, It.), "The influence of carbon monoxide on hydrogen absorption by thin films of palladium", *J. Electroanal. Chem.*, Vol 304, (1990), pp 233-239, 25 ref.

AUTHOR'S SUMMARY

(1) Adsorbed carbon monoxide inhibits the hydrogen absorption and desorption reactions in a thin-layer palladium electrode. A "blocking" effect of adsorbed hydrogen inside the palladium by adsorbed carbon monoxide is observed.

(2) During CO adsorption at 0.00 V [sic] an anodic current appears, probably due to the oxidation of adsorbed hydrogen during the exchange with carbon monoxide molecules.

(3) In addition to "bridged" and "linearly" bonded CO molecules as the predominant surface species, another adsorption product may exist on the palladium surface.

(4) Electrodes constructed by depositing a thin layer of Pd on gold allow the ratio between absorbed and adsorbed hydrogen to be decreased. This creates new possibilities for electrochemical studies of this metal.

E. LETTERS TO THE EDITOR

SKEPTICS DO BIASED REPORTING?
A letter from Thomas F. Droege

Dear Editor:

It has come to my attention that Douglas Morrison quoted an E-mail message from me at ACCF2 [Como Conference] after my paper was presented. ...

Since he apparently did not give the complete text, I thought that you might be interested in how the "skeptics" do biased reporting.

[Here is the complete E-Mail text:]

"There are lots of pulses. In fact there is a lot to see going on when one looks closely. Kim of Purdue has a theory that explains them as absorption instabilities. My measurements do not agree too well with his theory -- it would take a lot of work to sort out what is going on.

"But with some work I can make their average value go to zero within my error limits. There always seems to be a bias in favor of anomalous heat. Further, something always seem to happen before I get to the long charging time as proposed by Fleischmann and Pons.

"I am now an expert on how to get a false positive results. I can look at most of the papers - like Huggins - and show similar experiments which I interpret as null. But not all. Either Pons and Fleischmann are liars, or they have results which I cannot explain. Particularly troubling is the big heat pulse in the ACCF1 proceedings. I have looked at too much of this data to be fooled by fake data. The ACCF1 curves look real to me. I cannot see how they would have faked them and still put in all the stuff that I am now familiar with."

[Back to Droege's letter.]
I am also enclosing the written paper [presented at Como] for your files. I understand that it will have to be compressed for the Proceedings.

My classification is that I am seeing very interesting things. While there is a bias in my results towards anomalous heat, I am not ready to state that heat is seen with certainty. The work is very interesting, enough so that I continue at my own expense.

Regards, Thomas F. Droege.

A MORE IMPORTANT OBSERVATION BY DROEGE

From his E-mail correspondence, Droege states, "One thing that keeps me working is that I keep seeing things that I cannot explain."

Thomas Droege brings us a much more important point in his correspondence with Douglas R.O. Morrison. Here is the story: Morrison writes in his "Cold Fusion Update No. 4B" after referring to two papers by M.Srinivasan and E. Storms:

"Both these reviews have two major problems, (a) they do not review ALL the results, (b) they do not critically compare the data presented. In particular they do not explain the significance of the upper limits found. Let me explain by two examples - if the upper limit is the same value as the positive result, this does not mean too much as they balance; but if the upper limit is one hundred times lower than the positive results, then the probability of the positive results being correct is vanishingly small."

Droege points out in his correspondence with Morrison, "The problem with limits is that it is necessary to do the same experiment." And again Droege states, "We really do not know what experiment we are doing. Until we do, a small limit on the wrong experiment is worthless."

Invoking editorial privilege, the following is added: To see how little logic there is to Morrison's explanation, consider the following:

Two scientists set up to observe spontaneous combustion of oil-soaked rags. In case 1 the instrumentation is superb and capable of measuring heat 1,000 times more accurately than in case 2. However, in case 2 the rags burst into flames but in case 1 there is no spontaneous combustion. Is Morrison suggesting that we should give much more credence to the results of case 1 because the instrumentation is much better?

Sorry, Douglas R.O. Morrison, until we can perform identical experiments, with reasonably identical results, the negative results are useful only as documentation of what was tried that didn't work. One careful, well-instrumented, positive experiment is worth dozens of negative reports regardless of the "limits."

It is wiser to spend our time and our money on sharing information on what works and helping to advance, not destroy, this exciting new technology. Note that there were essentially no negative reports on cold fusion at the Como, Italy conference.

F. CONFERENCES & PAPERS

FINAL REPORT FROM NCFI

The four-volume final report from the NCFI is available from:

National Technical Information Service
U. S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161
Telephone: (703) 487-4650

The title: Investigation of Cold Fusion Phenomena in Deuterated Metals.
Vol I. Overview, Executive Summary, Chemistry, Physics, Gas Reactions, Metallurgy.
Vol II. Engineering.
Vol III. Theoretical and Collaborative Studies.
Vol IV. [Title not yet available] Pons & Fleischmann report.

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