4th Russian Conference on Cold Fusion and Nuclear Transmutation (RCCFNT4)

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Report by Prof. Hideo Kozima

Seven months after RCCFNT3[1], the RCCFNT4 was held in the same hotel Olympiskaya in Dagomys, Sochi as before, with Russian as the official language, with English translation. The hotel is on the coast of the Black Sea and has full facilities, with Russian hospitality.

There were 30 attendees, including four from countries outside of CIS, and there were 28 presentations (3). The presentations included 10 on theory and 18 on experiments.

The presentations showed the research progress in the seven months since the last Conference. Many of these reports will also be presented at the ICCF6 (October 13-17, Tohya, Japan) by the attendants of this Conference.

My brief report of the previous Conference was published in this journal[1] and was also repeated in the *Proc. RCCFNT3*. Following is my brief report on RCCFNT4, with comments (marked as *C*).

1996. 6. 20.

20–0. Opening Talk... Y. Bazhutov

20–1. L. Sapogin "Cold Nuclear Fusion and Energy Generation Processes in terms of The Schrödinger Equation"

The results obtained by the author's Unitary Quantum Theory given in the previous Conference were deduced from the Schrödinger equation for low energies. It was explained that the minimal distance between the nuclei can be made arbitrarily small, no matter how low the energy, and how large the nuclear charge, by choosing the initial phase values appropriately.

C. It is desirable to predict detectable quantities or analyze concrete data obtained in experiments.

20–2. I.B. Savvatimova, "Nuclear Transmutation Phenomena in the Palladium Cathode after Ion Irradiation at Glow Discharge"

In the flow discharge experiment with Pd cathode and D_2, H_2, Ar or Xe gas, amounts of the transmuted elements and isotopes in the cathode were analyzed by SIMS. The work follows that presented in the previous Conference, adding some new data. The amounts of the transmuted elements depended on the gas and increased in order of Ar(Xe), H_2 and D_2. The excess heat also increases in parallel with the amount of the transmuted elements.

20–3. H. Kozima, "Cold Fusion Phenomenon on TNCF Model"

Several typical experimental data obtained in these seven years after the discovery of cold fusion were analyzed using the TNCF (trapped neutron catalyzed fusion) model. Using experimen-

tal data of the excess heat, amounts of tritium, ^{4}He and/or NT (nuclear transmutation), the density of the trapped thermal neutrons was estimated. The result was consistent in itself and gave unified understanding of events occurring in the cold fusion materials.

C. This paper will be published in this journal.

20–4. Y.R. Karabut, "Registration of High Energy Products and Possible Phenomenological Explanation"

High energy electrons up to 2 MeV were observed in the glow discharge experiments with cathodes of Zr, Nb or Pd and gases H_2, D_2 or Ar. A possible explanation of the result was presented as by coherent enhancement of polar phonons in the cathode.

1996. 6. 21.

21–1. M. McKubre et al. "Calorimetric Studies at SRI"

The experiment with Pd/D_2O+LiOD and a recent experiment with Ni/H_2O+LiOH done in cooperation with CETI (Clean Energy Technol. Inc., USA) were presented putting emphasis on problems not explained in the previous Conference.

Conditions for the excess heat generation (the loading of D, the initiation of the reaction, the current density and the deuterium flux i.e. the time variation of D/Pd ratio) were explained. A feature of the excess heat generation, fluctuation with a period ~ 2 hours, was shown. The so-called "boiling off" in the experiment observed by Fleischmann et al. was realized and the condition for its occurence was determined.

Preliminary results of a research in SRI with Patterson Power Cell in cooperation with CETI was reported with a positive result.

21–2. Y.R. Karabut and I.B. Savvatimova, "Registration of Excess Heat in Glow Discharge with Various Cathode Materials"

To measure the excess heat in a discharge system, the authors constructed a closed chamber containing a discharge tube. With multi-layer cathodes Pd and/or Ni of sizes 1 x 1 cm^2 x 1 μm, the excess heats of 4 to 5 W were measured in D_2, H_2 or Ar gases. Gamma radiation was measured 30 ~ 45 days after the discharge and also transmuted elements were detected in the same sample. Elements with mass numbers near that of palladium were abundant in the cathode after the discharge. NT was observed in small regions near the boundary between layers.

21–3. N.I. Chochlov, "On the Problem of Excess Heat in the Process of Electrolysis"

It was pointed out that it is necessary for the calculation of the input power to take into consideration the voltage decrease in the electrolyte, especially when the cathode is nickel and the electrolyte is carbonate. A concrete example was shown with porous Ni cathode and H_2O+K_2CO_3 electrolyte.

21–4. J. Kasagi, "Low Energy D – D Reactions in Solids"

The experimental results with (1) $d + d + d$ reactions at $E_d \sim 130$ keV and (2) $d + d$ reactions in metal at $E_d \geq 2$ keV were presented.

Interestingly enough, new results in the experiment (2) with Ti and Yb targets showed 10 ~ 20% enhancement

of the probability for the $d + d$ reaction in the crystal than in a vacuum.

C. From my point of view, this result is favorable for TNCF model facilitating fusion reactions between low energy charged particles in crystal.

21–5. A. Lipson et al., "Heat Production, Nuclear Ashes and Electrophysical Processes in Heterostructure PdO/Pd/PdO saturated with Deuterium by Electrochemical Method"

(1) Thermal burst, (2) neutron emission and (3) gamma spectra from the heterostructure cathode occluded D(H) by electrolysis of (I) D_2O+NaOD and (II) H_2O+KOH solution were measured a) under a natural background neutron and b) with an artificial ^{252}Cf neutron source.

Synchronous signals of (1) and (2) were measured and compared each other. The most remarkable result would be the gamma spectra with large peaks at 2.2, 3.8, 4.2, 6.3 MeV and small signals up to 9.5 MeV which are the first clear measurement of the gamma spectrum. The peaks at 2.2 and 6.3 MeV were attributed by the authors to the following reactions:

$n + p = d + \gamma$(2.2 MeV),

$n + d = t + \gamma$(6.25 MeV).

With a ^{252}Cf neutron source, a strong peak at ~ 5 MeV appeared.

C. There was no explanation for the peaks except at 2.2 and 6.3 MeV. I proposed the following reaction for the peak at 4.2 MeV:

$n + {}^{16}O = {}^{17}O + \gamma$(4.2 MeV).

Furthermore, the peak at 3.8 MeV might be related with reactions including Na in the electrolyte, for instance:

$n + {}^{23}Na = {}^{24}Na^* = {}^{24}Mg + \beta^- + \nu_e + g$.

Thus, the observed γ spectrum could be used to show the existence of the trapped thermal neutron interacting with various lattice nuclei at special sites.

21–6. A.H. Labrenov, "High Temperature Boson Condensation and its Relation to Cold Fusion" — Waber Model

A summarization of J.T.Waber's paper with above title was introduced.

1996. 6. 22.

22–1. R.A. Stukan, "Effect of Tritium on Neutron Emission in D_2O Electrolysis with Pd Cathode"

Effect of a tritium layer of thickness 70 ~ 90 Å on the surface of Pd cathode was investigated measuring neutron signal from Pd cathode in electrolysis with D_2O+Li_2CO_3. The neutron emission was strangely intensified by the existence of tritium by a factor of 10.

C. The surface layer of tritium is favorable for the neutron trapping and it is expected that n_n increases to induce more reactions between n and ^6Li:

$n + {}^6Li = {}^4He + t$ (2.7 MeV).

The tritium with 2.7 MeV generated here can induce a neutron to be measured by the following reaction:

$t + d = {}^4He + n$ (14.1 MeV).

22–2. A.T. Lipson, "Influence of Thermal Neutron Background Level, D – H substitution and Crystal Mass on a Neutron Emission Intensity in Ferroelectrics in the Vicinity of T_c"

Using DKDP (TGS) as ferroelectrics, the change of neutron emission intensity in the thermal cycles around T_c (e.g. in 40 cycles) was measured. Interestingly enough, a decrease and an increase of the neutron counts were observed at different phases of a cycle.

The amount of the change was dependent on the intensity of the background thermal neutron.

cf. Lipson et al. *JETP Lett.* **62**, 828 (1995).

22–3. I.I. Shadrin, "C - Symmetry of Space - Time, Relation of u and v - Equations of Wave Packets with Cold Fusion"

Two coordinate systems related with a velocity difference larger than the light velocity c were taken up to investigate cold fusion phenomenon. A transformation relation between the two systems was used to investigate a system composed of two deuterons in matter interacting through multi-phonon mechanism. The state of the deuteron obtained as a result of the calculation will be used to analyze cold fusion data. A possible relation with cold fusion was discussed using the transformation relation.

22–4. I.I. Samoilenko, et al., "Investigation of Low Energy Nuclear Transmutation of Isotopes in Microbiological Cultures"

An experimental study of the nuclear transmutation of isotopes at ordinary temperatures was carried out by growing microbiological cultures under controlled conditions of growth. With the use of the Mössbauer effect, the formation of ^{57}Fe isotope from ^{55}Mn in a nutrient medium based on heavy water was observed.

22–5. V.N. Maidrov and V.A. Romodanov, "Probability Estimation of $d + d \rightarrow p + t$ Reaction in Power Glow Discharge in D_2 Gas"

Experiments generating a lot of tritium in glow discharge were analyzed from a stand point of the conventional d –d collision. It was concluded that the heavy tritium production observed in the experiments could not possibly be explained by the usual collision process.

C. I proposed an explanation based on TNCF model in the final session of the Conference (see below 24–5).

cf. V.A. Romodanov et al., *J. Techn. Phys. Lett.* **21**, 64 (1995).

22–6. L.I. Cholodov, "Structure of Matter in Vacuum"

A somewhat metaphysical interpretation of matter was presented in relation with cold fusion phenomenon.

1996. 6. 23

23–1. Yu.N. Bazhutov, "Influence of Spin and Parity Conservation Laws in Erzion-Catalyzed Nuclear Transmutation"

In relation with neutron emission and the nuclear transmutation by the erzion mechanism, the effects of the spin and parity conservation laws were discussed.

23–2. Yu.N. Bazhutov, "New Results on 'Yusmar' Hydro-Aggregate Nuclear Diagnostic"

Experimental results on the neutron detection from the "Yusmar" machine was presented with use of liquids D_2O+$LiNO_3$ ($CoSiF_6$, Li_2SO_4, etc.). Intermittent neutron bursts were observed which were difficult to interpret as background noise.

23–3. A.I. Koldomasov, "Nuclear Fusion in the Field of Electric Discharge"

The experiment reported in the previous Conference was reported more extensively. (In the previous report[1] there were some mistakes in the explanation of this experiment which will be

corrected in this report.)

In the center of a guide tube of a diameter 22 mm, there is a dielectric plug with a pinhole with a diameter 1.5 mm in the middle. The pressure difference of 40 to 50 atm with frequencies 1 to 5 kHz was applied between the sides of the plug filled with a liquid D_2O (H_2O) + electrolyte. Then, at the entrance of the pinhole, there appeared an electric potential up to 1.3 MV and neutron and gamma emissions were generated there.

An interpretation of the generation of neutron and gamma was given in terms of the formation of high temperature plasma at the pinhole and microcracks in the dieletrics.

cf. A.I. Koldomasov, *J. Tech. Phys.* **61**, 2 (1991).

23–4. I.P. Chernov and A. Mamontov, "Nuclear Reactions in Solids Stimulated by Hydrogen Isotopes."

Samples of Nb, Ni, Pd, stainless steel and Ti were stimulated with D or H atoms by glow discharge, rf discharge or electrolysis of D_2O+LiOD. Neutron, gamma and acoustic signal generations were measured with low correlation between them. A neutron signal of up to 100 times the background level and acoustic signal were observed intermittently.

An interesting feature of the experiments was the "after switch-off" detection of signals of gamma and phonon 40 s to 10 min. after the switch-off of the discharge voltage with no neutrons at all.

23–5. K. Kaliev and B.A. Filimonov, "Neutron Bursts and Accompanying Effects in Deuterium Absorption by Structured Film of Na_xWO_3."

Single crystal multi-layers (thickness ~ 1 μm) of Na_xWO_3 (x = 0.8 to 0.9) was precipitated on the surface of tungsten wire of a diameter 200 μm from a Na_2WO_4+WO_3 melt. Clear neutron bursts containing 20 to 25 neutrons/burst were measured several times. The experiment is now going on.

23–6. A.L. Samgin, et al., "On Anomalous Phenomena in High Temperature Protonic Conductors — Search for Correlation with Electrical and Structural Properties and Phase Transition."

In the oxide proton conductor $ACe_{1-a}d_xO_{3-d}$ (A: Ba, Sr; d: Nd, Dy, Yb), relations among anomalous phenomena, i.e. the excess heat, neutron burst etc. and physical properties of the material, i.e. conductivity, structural properties, phase transition, were investigated. Qualitative relations were obtained.

1996. 6. 24

24–1. G.I. Fedorovich, et al. "Nuclear Phenomena under Electrochemical Stimulation of the Deuterated TGS (DTGS) Crystals."

The effects of (1) mechanical demolition, (2) cryogenic excitation in liquid N_2, (3) thermocycling in a temperature region 20 ~ 100°C and (4) polarization reversals were investigated on DTGS and $LiTaO_3$.

Neutron emission was confirmed in two cases of (3) and (4). Especially strong neutron emission, about ten times the background count was obtained in deuterated $LiTaO_3$ in the process (4).

24–2. A. Lavrenov and B.I. Filimonov, "On Electromagnetic Interaction for

Generation of Collective Mode in the Solid with Reference to Cold Fusion."

A two-level atom in the one-mode field was analyzed theoretically to show an existence of a collective mode. As a result, localization of the electrons on some states occurs as a lattice structure in solids which may have some connection with cold fusion phenomenon.

24–3. A.V. Bulyga, "On an Additional Effect in Energy Conversion Process including Cold Fusion and Nuclear Transmutation."

A philosophical standpoint to treat cold fusion and NT was expressed in relation with the classical thermoelectric effect.

24–4. N.V. Samsonenko, "On the Barut-Vigier Model of Hydrogen Atom"

The Schrödinger equation for a hydrogen atom with spin-orbit interaction was solved exactly obtaining a level with an energy of – 80 keV for n = 2 and $l = 1$ state. It was discussed that the small radius of the orbit of this state would have relation with $d - d$ fusion supposed to occur in cold fusion materials.

24–5. Comment on the Presentations in this Conference.

H. Kozima, Re:"Analysis of Experimental Results by Lipson et al,, Romodanov et al. and Savvatimova et al. on TNCF Model."

Using the TNCF model, some characteristics of the experimental data obtained by the authors listed in the title were analyzed to give the density of the trapped thermal neutron in these samples.

1. In the powerful glow discharge experiment with Mo cylindrical cathode (2 cmϕ x 10 cm) and D_2 gas, Romodanov et al.[2] observed a large amount of tritium generation up to 10^{13} atoms/s with low n/t ratio down to 10^{-9}. The cathode was heated up to 3600 K in the discharge.

Assuming an existence of the trapped thermal neutron with a density n_n in the sample and the fusion reaction with the occluded deuterons, the density n_n was determined using experimental values of the tritium generation rate n_t, n–d fusion with a cross section $s_{nd} \sim 5.5 \times 10^{-4}$ barns to generate t and γ by the following relation[3]:

$$N_t = 0.35 n_n v_n n_d V s_{nd} \quad (1)$$

where v_n is the thermal velocity of the trapped thermal neutron, V is the volume of the sample, and n_d is the density of deuteron in the sample. The estimation gives:

$n_n = 3 \times 10^7$ cm^{-3}, with $n_d = 10^{18}$ cm^{-3}.

If the neutron was generated only by a reaction $t + d = {}^4\mathrm{He} + \mathrm{n}$, a calculation gives a ratio $n/t \sim 10^{-5}$ which is compared with the experimental value 10^{-7}.

2. Lipson, et al.[4] observed γ spectra for the first time between 2 ~ 10 MeV in heterostructure PdO/Au/Pd/PdO:D_x·Na(H_x·K). In the spectrum, there are several peaks at about 2.5, 3.5, 4.0, 6.5 MeV and small signals at about 5.5, 8.0, 9.0 and 9.5 MeV.

The authors attributed peaks at 6.5 and 2.5 MeV to γ's generated in the reactions

$$n + d = t + \gamma\,(6.25\ \mathrm{MeV}), \quad (2)$$

$$n + p = t + \gamma\,(2.2\ \mathrm{MeV}). \quad (3)$$

The cross sections of these reactions for the thermal neutron are 5.5×10^{-4} and ~ 0.35 barns, respectively.

On the TNCF model, following reactions other than the above ones are possible between the thermal neutron

and nuclei in the present sample:

$n + {}^{16}O = {}^{17}O + \gamma$ (4.2 MeV), (4)

$n + {}^{23}Na = {}^{24}Na^* = {}^{24}Mg + e^- + \nu_e (+\gamma)$(5)

$n + {}^{104}Pd = {}^{105}Pd + \gamma$ (7.1 MeV), (6)

$n + {}^{105}Pd = {}^{106}Pd + \gamma$ (9.4 MeV). (7)

$n + {}^{39}K = {}^{40}K + \gamma$ (7.9 MeV). (8)

Those γ's possibly generated could be responsible for the peaks observed in the spectrum.

From the intensity of γ with ~ 4.2 MeV supposed to be generated in PdO layer, we could estimate n_n in the neighboring Pd layer as $n_n = 4.4 \times 10^4$ cm^{-3}, assuming the efficiency of γ measurement as 10% in the experiment.

From the intensity of γ with ~ 6.5 MeV generated in Pd/D layer, we could estimate n_n as $n_n = 1.5 \times 14$ cm^{-3}, assuming the reaction occurs only in the boundary layer of a thickness ~ 1 μm.

3. Savvatimova, et al.[5] observed changes of isotope compositions in Pd multi-layers used as the cathode of the glow discharge experiment with D_2 gas. Especially interesting example of the change is an increase of ^{107}Ag from 20 to 5×10^3 ppm in 3 months after an experiment of a glow discharge lasted 4 hours.

A reaction:

$n + {}^{106}Pd = {}^{107}Pd^* = {}^{107}Ag + e^- + \nu_e$,(9)

gives an answer for the generation of ^{107}Ag in the experiment. The estimation similar to that used above with the reaction region in the surface layer of thickness 1 μm gives $n_n = 8.6 \times 10^{10}$cm^{-3} which is consistent with other data given for Pd samples used in the electrolysis and discharge experiments.

The result of analyses of the data obtained in Russia together with those given in the report 20–3 shows a consistent physics responsible to the cold fusion phenomenon occurring in the materials with hydrogen isotopes.

To clarify the physics of the cold fusion phenomenon, it is desirable more intimate dialogues between the experiment and the theory.

24–6. Closing Talk.....Y. Bazhutov.

Appendix

"Requests for the Presentation of Experimental Results" (Comment after the Conference). I made some requests to theoreticians for their presentation last year1. This time, he wants to ask to experimentalists following requests for their presentation.

The comments 24–5 given in the final session of the Conference became possible after long conversations with researchers, asking them about concrete experimental conditions. The necessary information to analyze their data using the TNCF model was not fully written in their reports.

From my point of view as a theoretician wanting to analyze experimental results, it is desirable to have following data on the experimental condition in reports:

1) Dimensions of the sample,

2) Duration of the experiment including periods without effects,

3) Intervals between successive measurements if any,

4) Clear description of the relation between the effects and the sample used,

5) Quantitative results are preferable than qualitative ones.

References

(1) H. Kozima, "Third Russian Conference on

Cold Fusion and Nuclear Transmutation (RCCFNT3)", *Cold Fusion* **15**, 18 (1995) and also *Proc. RCCFNT3*, p. 11 (1996).
(2) V.A. Alekseev, I.I. Borisov, V.A. Vasil'ev and V.A. Romodanov, "The Tritium Generation by Interaction of Dense Plasma Flux with Metal Surface" *J. Tech. Phys. Lett.* 21, 64 (1995) and private communication.
(3) H. Kozima, "Analysis of Cold Fusion Experiments Generating Excess Heat, Tritium and Helium", *J. Electroanal. Chem.* (to be published)
(4) A. G. Lipson, D. M. Sakov and E. I. Saunin, "Suppression of Spontaneous Deformation in Triglycine Sulfate Crystal (D\suf$_{0.6}$H$_{0.4}$) by a Weak Neutron Flux" *JETP Lett.* 62, 828 (1995) and private communication.
(5) I.V. Savvatimova and A.B. Karabut, "Change of Elemental and Isotope Composition in Pd-Cathode after Ion Irradiation by Glow Discharge", *Proc. RCCFNT3*, p. 20 (1996) and private communication.

P.S. Proceedings of RCCFNT3 held last year (1995) in Sochi was published just before this Conference and distributed among participants. "Erzion" Scientific Research Center, Moscow (Russia) can send you *Proceedings of Russian Conference on Cold Fusion and Nuclear Transmutation*, now published. There are four issues, *RCCFNT0* (1992) to *RCCFNT3* (1995). (*RCCFNT0* is "Chalodny Yademy Sintez", ed. R.N.Kuz'min (1992) containing materials on the cold fusion research in Russia until 1991). Price is $50 each including mailing. Please write to: "Erzion" Scientific Research Center of Phys. Tech. Problems, P.O. Box 159, 105077 Moscow, RUSSIA.