Nuclear Structure Aspects of Low-Energy Nuclear Reactions (LENR)

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There are three distinct aspects of LENR phenomena: (1) the solid-state/chemical environment, (2) the underlying quantum mechanics of the reacting components, and (3) the complex many-body problem of nuclear structure itself. While many researchers have addressed (1) and (2) over the past 26 years, the uncertainties and inherent contradictions within nuclear structure theory have been largely neglected. The unfinished business of nuclear structure – left over from the 1950s and 1960s – must however eventually be addressed in LENR, insofar as the high energies of the atomic nucleus are involved.

Prior to the discovery of LENR phenomena, Wigner [1], Everling [2], Lezuo [3] and Cook [4] developed a lattice model of nuclear structure. As first noted by Wigner [1] in his formulation of the independent-particle model (IPM) (Nobel Prize, 1963) there is an inherent 3D geometry of the symmetries of the nuclear Hamiltonian. Those symmetries were later successfully exploited in the development of the shell model, but the geometrical implications explicitly noted by Wigner (Fig. 1A) were neglected. Subsequently, others [2-4] have shown how the quantal symmetries of the IPM provide constraints on the nuclear force and suggest a way to unify nuclear structure theory within the lattice framework (Fig. 1B, C). Most significantly, the lattice packing of nucleons has concrete implications for the nuclear force that can be used in defining specific nuclear structures for the ground and excited states of the isotopes relevant to LENR.

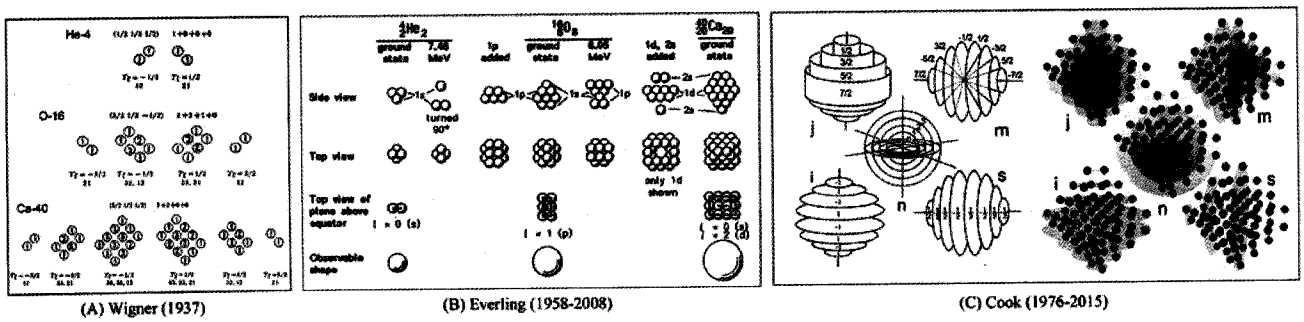

Figure 1: The geometrical (fcc lattice) symmetries of nucleon quantum states, as illustrated by Wigner (A), Everling (B), and Cook (C). The extreme ***complexity*** of the 30+ models that are used in conventional nuclear theory obscures the extreme ***simplicity*** of the mathematical symmetries of the quantal states of the nucleons themselves. Notably, a liquid-drop-like texture (near-neighbor interactions only) and alpha-particle (tetrahedral nucleon clustering) are implicit to the lattice.

The mathematical basis for asserting a lattice substructure for nuclei is a straightforward mapping between an fcc close-packed lattice of nucleons and quantum symmetries:

principal, $\boldsymbol{n} = (|x| + |y| + |z| - 3) / 2$
total angular momentum, $\boldsymbol{j} = (|x|+|y|-1)/2$
azimuthal, $\boldsymbol{m} = (|x| * (-1)(x-1)/2) / 2$
spin, $\boldsymbol{s} = ((-1)(x-1)/2) / 2$
isospin, $\boldsymbol{i} = ((-1)(z-1)) / 2$
parity, $\boldsymbol{\pi} = \text{sign}(x*y*z)$

where all quantum numbers are defined in terms of the nucleon's unique set of x, y, z coordinates in Cartesian space. ***All*** of the nucleon shells/subshells and their occupancies are thereby produced – indicating that the IPM and the lattice model are isomorphic. The gaseous-phase IPM and the lattice differ, however, in implying a diffuse nuclear interior, on the one hand, or a high-density nuclear interior where nucleon-nucleon interactions are local, on the other. Using a "mean field" approximation, the IPM has been the dominant model since the 1950s, but it cannot be reconciled with the known nuclear force that has been measured with great precision (Fig. 2). In contrast, the lattice has a liquid-drop-like texture that is consistent with the known dimensions of the nuclear force. The significance of the ***short*** nuclear force for the transmutation phenomena in LENR will be discussed.

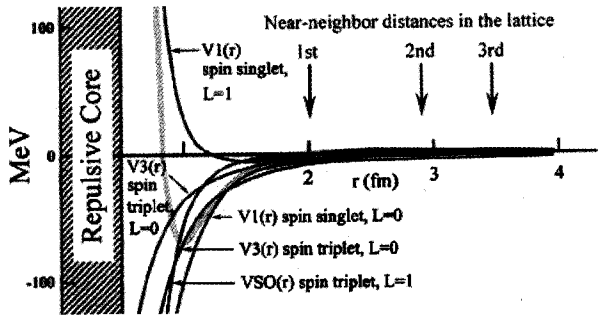

Figure 2: The short-range nuclear force (above) known from nucleon scattering experiments is ***inconsistent*** with the "mean field" approximation of the conventional IPM. In contrast, the lattice model requires such a short-range force.

References

[1] E. Wigner, *Physical Review* **51**, 106 (1937).
[2] F. Everling, *Journal of the Physical Society of Japan* **75**, 124201 (2006), www.everling-nuclear-lattice-model.com
[3] K. Lezuo, *Atomkernenergie* **23**, 285 (1974).
[4] N.D. Cook, *Physical Review* **C36**, 1883 (1987); *Models of the Atomic Nucleus*, 2nd ed., Springer, New York (2010);. www.res.kutc.kansai-u.ac.jp/~cook/PDFs/MAN2.pdf

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Influencing Radioactivity via Transmutation

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There are à number of radioisotopes, and low energy treatment cannot influence their usu activity (according to mainstream physics). However, transmutation methods îÛÍåãåï1 LENR methods have shown some promise for industrial applications.

We have attempted to decrease the radioactivity level of natural uranium, as the only a~a~~ source of radioactive material.

The natural uranium comes in form îÏ32ß04, also known as "yellow cake." (There werc also some additional chemical impurities).

The treatment method was the "nano dust fusion" method. The treated uranium sample âû ground to à fine dust, mixed with carbon particles, and then treated in à microwave generat oscillating plasma for about 3-4 minutes. This treatment changed the y radiation level of t1ê~ mixture.

The treatment was carried out in à mild vacuum at about 0.5 bar. The radiation reduction effect ÷~àûïîãå marked when stable but heavy elements like lead oxide were added to the treated mixture. When lighter elements were added to the treated mixture, the reduction eff vanished after about 2-3 weeks.

However, there is à side effect — the f3 radioactivity level increases due to the treatment, m probably because the carbon is activated.

Even this might be à reasonable trade off, since carbon isotopes have much shorter half peri of radioactivity then heavier isotopes.

The scope of investigation has been limited due to the scarcity of available radioactive materials, and limited funding.

The method is ø its infancy, especially the treatment of radioactive materials.

It seems that the method is suitable for the treatment of high level radioactivity (like spent fuel) way above the background level.

Even that might be suitable for the treatment of spent fuel;

The bulky, low level radioactivity of soil is not suitable for this kind of treatment

The electrical power input is usually 1000-1200 W, but most of the heat can be recovered ãï used for heating if needed.

At present the samples were treated in an intermittent manner, about half cubic cm3 at one time, but in principle continuous feeding is also possible.

Final report on SKINR replication experimental program to seek excess heat using Ni powders mixed with $LiAlH_4$ and free Li under high temperature Hydrogen gas

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Twelve tests were conducted by the University of Missouri - SKINR group to evaluate the thermal behavior of Carbonyl Nickel powders mixed with $LiAlH_4$ in a Hydrogen filled ceramic tube subjected to variable temperatures up to 1300°C. The goal of this test series was to first create a high temperature gas loading cell similar to that demonstrated in 2015 by Dr. Parkhomov and then to use this test setup to confirm Dr. Parkhomov's ICCF19 report of excess heat.
Two different Ni powders and various amounts of $LiALH_4$ and free Li along with several heating profiles were used in the twelve different multi-day tests. The first nine tests used commercial Hunter Chem Grade AH50 Nickel powder mixed with commercially procured $LiALH_4$. The last three tests used custom Nickel powder, provided by Parkhomov via Bob Greenyer from MFMP, which was mixed with $LiAlH_4$ and free Li powders provided by MFMP.
Most of the tests closely followed the set-up, operation, and heating protocols previously used by Dr. Parkhomov and/or MFMP which were reported to yield excess heat. No indications of excess heat were observed during any of SKINR's twelve experimental trials.

A20

Neutron Synthesis via Arc Discharge in Low-Pressure Hydrogen Plasma: Successful Replication of Earnest Sternglass Experiment

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I report successful replication of infamous 1951 experiment by Earnest Sternglass whereby neutron are apparently synthesized in an arc discharge in low-pressure hydrogen. The original work b Sternglass created quite a stir at Cornell, but despite recommendation and encouragement fro Einstein sadly remained unpublished [1].

The modern version of this experiment involves passing a 20-30mA current at 20-30kV through demountable X-ray tube filled with hydrogen. Neutron flux is measured directly with ^{3}H proportional counter and indirectly via activation of various metal foils.

The neutron synthesis under these conditions implies that electrons do combine with protons t form neutrons under low energy conditions. I offer a theoretical explanation for this phenomeno which is quite conventional: when analysing electron dynamics until now we have been ignorin the inductance of the electron beam. I show that in high-current discharges the inductance of th electron beam plays dominant role in electron scattering dynamics by generating massive EM which imparts the scattering electron with additional energy large enough to penetrate the Coulom barrier and gain relativistic mass necessary balance the energy budget in the neutron synthes reaction. As has been suggested by Einstein in 1951 it is indeed a 'collective' electron effect th manifests itself only when significant currents are present and is therefore virtually non-existe when particle accelerators or low-density beams are used. The same mechanism can explain neutro synthesis in lightning bolt discharges, which have been recently recreated in the lab [2], heliu production during tungsten wire explosion as reported by Wendt & Irion [3] and recent replicatio of the experiment by the author [4].

The key motivation for this work was to derive a simple and easily reproducible experiment th undeniably demonstrates LENR phenomenon and thus once and for all closes the discussion o whether LENR is possible or real. I believe that the direct confirmation of neutron synthesis und low energy conditions is the badly needed potently convincing evidence that will set LENR on firm theoretical footing and thus pave the way to intense and rapid academic research backed b government funding. In my opinion the lack of funding for organized basic research is the singl largest obstacle holding back LENR science.

References:

[1] E. Sternglass, Unpublished Notes, Cornell University Archive, 1951.
[2] A. Agafonov et al., "Observation of neutron bursts produced by laboratory high-voltag atmospheric discharge", Phys. Rev. Lett., vol. 111, 115003, 2013.
[3] G. Wendt, C. Irion, "Experimental attempts to decompose tungsten at high temperatures", J. Am Chem. Soc, vol. 44, no. 9, pp. 1887-1894, 1922.
[4] Max Fomitchev-Zamilov, "Helium production in plasma arc discharge: successful replication o Wendt & Irion tungsten wire explosion", ICCF20 Conference Proceedings, Sendal, Japan, 2016.

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Patents in the Land of LENR
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Interested observers of developments in the field of LENR were awakened by the first publication and issuance of à US patent to Leonardo Corporation, based on an invention by Andrea Rossi, on August 25, 2015. That US patent has its special story as to the procedure followed before the US Patent Office. It was processed in secret without the normal publication that occurs after 18 months from à first patent filing. This patent has some relevance. But it has now been followed by the publication of à corresponding, enhanced, PCT application. The more interesting issue is: Will these or any îáæåã patent filings eventually have à controlling impact on developments in the field of LENR?
This paper provides à concise review of key patent principles which should be understood by everyone concerned about this issue. Misconceptions abound. It is important that anyone wishing to understand the possible impact of patents on the development of LENR understand correctly what patents can and cannot accomplish.
Patents are referenced ø à legal action commenced before the United States Federal District Court in Florida, filed on April 5, 2016. This action was commenced by Leonardo Corporation and Andrea Rossi against Industrial Heat, some of it is some related corporations and key individuals associated with these companies. This action will not likely ñîòå to à trial until sometime in 2017 at the earliest. It could also settle at any time. That action is essentially an effort to collect US$89 Million arising out of an agreement made between Industrial Heat and Leonardo Corporation in 2012. The status of those proceedings as of the beginning of October, 2016 will be reviewed.
Industrial Heat is accused of having improperly filed for two applications on its own both naming Andrea Rossi as at least à ñî-inventor. Apparently, based on the allegations in the lawsuit this happened without the consent of Andrea Rossi. How this could happen will be reviewed. However, equally significantly, these two patents will be examined for the apparent thinking and understanding that existed within Industrial Heat when these patents were first prepared 2 ~~ years ago.
Reference will be made to several other US patents that have issued in this field, and others that ha ve
been refused by the US Patent Office. Reference will also be made to selected patents that have been processed before the European Patent Office, including in particular the original patent that issued in Europe based on the work of Fleischman and Pons.
The paper will conclude with à projection as to the impact that prospective future patents in the LENR field òàó have on commercialization of LENR around the world.

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Validation of Brillouin Energy Corporation Hydrogen Hot Tube Experiments

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The author conducted an independent validation of the power output of the Brillouin Ener Hydrogen Hot Tube ("HHT") experiments at both SRI and the company's Berkeley facility. T results show with very high confidence excess energy output above chemical and likely due t nuclear interaction of 12 to 20 watts over an 18 to 24 hour period several times during the spring a summer of 2015. This power level was above the amount of energy that could be produced by kno chemical reactions within the system. Further work can be done to eliminate the remaining uncertai factors and to demonstrate enhanced controllability using Brillouin's Q-Pulse Technology.

Keywords: LENR, CECR, Low Energy Nuclear Reaction, Controlled Electron Capture, Hydroge Nickel, Cold Fusion
PACS: 25.10.+

Pd, Se, Zr Transmutation Experiments induced by D_2 gas permeation with the nano-sized Pd complexes

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Nuclear transmutation - Cs->Pr, Sr->Mo, Ba->Sm - induced by D_2 gas permeation through nano-size Pd/CaO multi-layer complex, was reported by Iwamura et al. [1][2] . We aimed to develop a new method of nuclear waste decontamination for ^{107}Pd, ^{79}Se, ^{93}Zr, ^{135}Cs and ^{137}Cs, using this deuterium permeation process. Firstly, we tried to perform transmutation experiments using stable isotope Pd, Zr and Se doped on Pd/CaO multi-layer complex.

Samples are prepared as follows: The Pd/CaO complex is composed of bulk Pd on the bottom, alternating CaO and Pd layers, and a Pd thin film on top[1]. For the formation process of the complex, the Ar ion beam sputtering method or the magnetron sputtering method was employed. In the case of the Zr sample, we doped Zr using ion beam sputtering in the Pd complex. For the Se sample, we implanted Se ions under the condition of 10kV and 10^{15} Dose on the Pd complex with an ion implantation apparatus (EXCEED2300AH NISSIN ELECTRIC Co.,Ltd).
We set these samples in experimental device and carried out D_2 gas permeation for about one week. Element and mass analyses on the Pd complexes were made by XPS (X-ray Photoelectron Spectroscopy) and ICP-MS (Inductively Coupled Plasma Mass Spectrometry). We compared the results on foreground samples with those without D_2 gas permeation.

We observed some indications on the transmutation of stable Pd and Se, although further study is required. In the case of Pd, ICP-MS analysis suggested that ^{106}Pd transmuted to ^{114}Sn. In XPS analysis, weak signals of Zr and Sr were detected on the Se doped samples after D_2 gas permeation. However, we observed no indication of the transmutation of Zr.
We will report on the results in detail.

This work was partly supported by IMPACT Program of Council for Science, Technology and Innovation in 2015. Program name is "Reduction and Resource Recycle of High Level Radioactive Wastes with Nuclear Transmutation"
Institute for Materials Research, Tohoku University supported sample preparation using Magnetron spattering. Ion implantation was supported by New Industry Creation Hatchery Center, Tohoku University. Department of Instrumental Analysis Technical Division School of Engineering Tohoku University supported XPS and ICP-MS analysis.

References

[1] Y. Iwamura et al., Jpn. J. Appl. Phys. 41 (2002) 4642.
[2] Y. Iwamura, T. Itoh and S.Tsuruga, Current Science, VOL.108, NO. 4, 25, 2015.

A40

Anomalous Excess Heat Generated by the Interaction between Nano-structured Pd/Ni surface and D_2/H_2 gas

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Tadahiko Mizuno and his colleagues have been developing excess heat generation meth and devices for the past few years [1]-[2]. They fabricated the nano–structured Ni and Pd surf using plasma discharge and then D_2 gas (100~300 Pa) was subjected to the nano–structured Ni Pd at 200℃. They observed excess heat several times. For example, they observed about 78W exc power that is almost the same as input power.

The authors do not have much experience on excess heat experiments. So we started exc heat experiments similar to the above Mizuno experiments. At first, temperature measurements w performed using a non-fabricated Pd wire with 7W and 40W heater input powers under several ki of D_2 gas pressures (0~300Pa). The temperature was measured near the Pd wire by a thermocou and used as "background" data. After evacuating D_2 gas, we fabricated the nano–structured Pd Ni thin film on the Pd wire using plasma discharge. And we introduced D_2 gas and measu temperature under the same D_2 gas pressures and the same heater input powers as those of backgro

About 120K temperature increase were observed in the case of the nano–structured Pd thin film on the Pd wire with 7W power input. The temperature near the Pd wire with nano-structu Pd/Ni was 700K, although the Pd wire without nano-structured Pd/Ni was 581K. Environme temperature, D_2 gas pressure and input power were all the same for these experiments. Fur experimental results and numerical analysis on heat conduction and radiation will be presented.

Recently, we developed a new type of experimental apparatus that can provide high press D_2/H_2 gas up to 0.3Mpa. Experimental results with this new apparatus also will be presented ICCF20.

Acknowledgment

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References

[1] T. Mizuno, "REACTANT, HEATING DEVICE, AND HEATING METHOD", Pa Application, WO2015/008859 A2.

[2] H. Yoshino, E. Igari and T.Mizuno, Presentation at 2014 CF/LANR Colloquium at M March.21-23, 2014, Massachusetts Institute of Technology, Cambridge, MA, USA.

Replication Experiments at Tohoku University on Anomalous Heat Generation Using Nickel-Based Binary Nanocomposites and Hydrogen Isotope Gas

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We are building a new experimental system at the Condensed Matter Nuclear Reaction Division of Tohoku University. One of the aims of the system is to replicate the anomalous heat generation experiments reported by A. Kitamura and A. Takahashi et al [1].

The system is intended to measure precisely heat generation using a flow-calorimetry method when hydrogen isotope gas, up to 1.0MPa, is loaded into Ni-based binary nano-composites. The loading temperature ranges about from 300K to 600K. A liquid hydrocarbon coolant enables us to use the flow-calorimetry method at temperatures higher than 373K. The new experimental system is based on the paper [1], but improved regarding to the number of temperature measurement points and some functions.

The Ni-based binary nano-composite samples made from an amorphous mixture of metal elements were prepared by the melt spinning method at Kobe University. By annealing the mixture in air at a temperature of 723K for 60 hr, preferential oxidation of Zr to ZrO_2 was expected with formation of nanoparticles of Ni and Pd embedded in it. A fabricated material at Kobe University that consists of $Pd_{0.04}Ni_{0.31}Zr_{0.65}$ was separated into two samples. One sample was loaded and tested at Tohoku University and the other at Kobe University.

The following can be said based on the preliminary analysis:

1) About 10W anomalous excess heat lasting at least for 90h was observed when the loading chamber temperature was from 500K to 570K, although excess heat was not clearly observed when it was from 333K to 473K.
2) Estimated total amount of excess energy reached up to a few MJ order; 1.6MJ per absorbed 1 mole D (equivalent to 16 eV/D), which is supposed to be difficult to explain by chemical processes only.
3) For the samples subjected to the same fabrication process, results of the present work qualitatively agreed with those of the similar experiment performed at Kobe University.

Acknowledgment
The authors would like to acknowledge Mr. Y. Shibasaki for his support for establishing experimental system. We also would like to thank Prof. Y. Furuyama, Prof. M. Kishida, Mr. M. Nakamura, Mr. M. Uchimura, Mr. H. Takahashi, Ms. R. Seto, Ms. Y. Matsuda, Dr. T. Hioki, Prof. T. Motohiro for their supports and valuable discussions.

References

[1] A. Kitamura, A. Takahashi, R. Seto, Y. Fujita, A. Taniike and Y. Furuyama, "Brief summary of latest experimental results with a mass-flow calorimetry system for anomalous heat effect of nano-composite metals under D(H)-gas charging", Current Science, vol. 108, no. 4, pp. 589-593, 2015.

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Collaborative Examination on Anomalous Heat Effect Using Nickel-Based Binary Nanocomposites Supported by Zirconia

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Hydrogen isotope absorption by nickel-based nanocomposite samples has been examined as a collaborative work using the experimental apparatus installed at Kobe University in order to share scientific understanding of the anomalous heat effects both at room temperature (R.T.) and elevated temperatures. The system [1] has a reaction chamber containing the sample with a capacity of 500 cc, and a flow-calorimetry system capable of working at elevated temperatures up to 300 °C with use of a liquid hydrocarbon coolant. The samples tested so far include $Pd_{0.044}Ni_{0.31}Zr_{0.65}$ ("PNZ3") and $Cu_{0.044}Ni_{0.31}Zr_{0.65}$ ("CNZ5"), whose absorption characteristics are discussed in the present paper.

Both samples were made from the amorphous mixture of the metal elements prepared by melt spinning method. By annealing the mixture in air at a temperature of 450 °C for 100 hr ~ 60 hr, preferential oxidation of Zr to ZrO_2 is expected with formation of nanoparticles of Ni and Pd or Cu embedded in it.

The PNZ3 sample showed a very strong absorption with a molar ratio of the absorbed hydrogen isotopes to the Pd and Ni atoms in the sample; $L_M \equiv$ D(H)/Pd·Ni ~ 4 for the virgin PNZ3 sample at R.T., and L_M ~ 2 for the sample at R.T. after every degassing process at a temperature higher than 200 °C following repeated cycle of elevated temperature runs. The associated thermal output W_a was 0.6 eV/D and 0.4 eV/D(H), respectively, which are more than two times of that by the bulk Pd sample. The CNZ5 sample, on the other hand, showed a modest absorption with $L_M \equiv$ D(H)/Ni ~ 0.2 and W_a ~ 0.5 eV/H at R.T., while at an elevated temperature of about 200 °C, it showed a strong absorption similar to the PNZ3 at R.T. Both samples showed excess power output on the level of 5-10 W at elevated temperatures up to 350 °C for several days and integrated anomalous heat on the level of 0.5 GJ/mol-D(H).

Material characterization by XRD, ICP and STEM-EDS prevailed interesting features of the samples including formation and disappearance of crystalline phases of $NiZr_2$, Ni_2Zr, ZrO_2, etc. The effect of the phase transition on the excess power generation will be discussed in some detail.

[1] *e.g.*, A. Kitamura, A. Takahashi, R. Seto, Y. Fujita, A. Taniike and Y. Furuyama, "Brief summary of latest experimental results with a mass-flow calorimetry system for anomalous heat effect of nano-composite metals under D(H)-gas charging", Current Science, vol. 108, no. 4, pp. 589-593, 2015.

Calorimetric study of hydrogen absorption in nanocomposite materials prepared from $Pd_xNi_{30-x}Zr_{65}$ ($0 \leq x \leq 35$) amorphous alloys

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Nanocomposite materials, similar to those originally used by Y. Arata [1] to investigate LENR in the Pd-D system [2], were synthetized via oxidation of metallic amorphous alloys with starting composition $Pd_xNi_{30-x}Zr_{65}$ ($0 \leq x \leq 35$). The synthesis procedure was based on the work of Kimura et al. [3] The as-prepared materials were studied by means of X-Ray Diffraction (XRD) and Differential Scanning Calorimetry (DSC). Studies of the interaction of samples with hydrogen isotopes were carried inside a commercial high pressure DSC.
Rietveld refinement on XRD patterns of the as-prepared materials showed the presence of a zirconium oxide matrix in all samples and, depending on the starting composition, nanosized domains of NiO, PdO, $NiZr_2$ and Pd as the main other phases.
DSC analysis in hydrogen isotopes atmosphere at room temperature showed different exothermic behaviour depending on the sample content of Ni. A change of phase composition was observed in some samples after the first interaction with hydrogen, due to the reduction of NiO and PdO phases to metals, as confirmed by XRD. After a desorption cycle in vacuum up to 550 °C, a second absorption cycle was performed at room temperature, showing for all the samples a reduced amount of heat. The contributions of different chemical reactions to the observed effects are discussed.

[1] S. I. Yamaura, K. I. Sasamori, H. Kimura, A. Inoue, Y. C. Zhang, Y, Arata, "Hydrogen absorption of nanoscale Pd particles embedded in ZrO_2 matrix prepared from Zr-Pd amorphous alloys", Journal of Materials Research, vol. 17, no. 6, pp. 1329-1334, 2002.
[2] Y. Arata, Y. Zhang, "The Establishment of Solid Nuclear Fusion Reactor", Journal of High Temperature Society, vol. 34, pp. 85-93, 2009.
[3] H. Kimura, A. Inoue, T. Masumoto, "Production of nanocrystalline ZrO_2 and Pd composites by oxidation of an amorphous $Zr_{65}Pd_{35}$ alloy", Materials Letters, vol. 14, no. 4, pp. 232-236, 1992.

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Progress in Development of a Power Source Based on Low Energy Nuclear Reactions (LENRs)

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As described in ICCF-18 [1] we are studying anomalous heat, attributed to Low Energy Nuclear Reactions (LENRs), generated from metal alloy nanoparticles loaded with hydrogen (or deuterium) through pressurizing the vessel containing the particles. The primary result thus far is that the excess energies observed in experiments to date are all well above maximum estimation of what could be attributed to known chemical reactions. The discovery of ultra-high-density hydrogen cluster formation in void and dislocation loops has allowed us to develop host materials that give reasonably reproducible results [2, 3]. The hydrogen in these clusters is close to metallic density and theory shows the cluster atoms can react when another hydrogen diffuses in transferring momentum to the cluster atoms.

The external power/energy input involved is minimal compared to the output, indicating a large energy gain. Due to the low energy of the ion initiating the reactions (vs. fission and hot fusion reactions), the compound nucleus formed has little excitation energy. Thus it follows decay channels leading the stable or near stable reaction products. As result, despite these being nuclear reactions, the products have minimum radioactivity. In view of its very high energy density and lack of significant nuclear waste, power units based on LENRs are very attractive for distributed power units that serve in a renewable energy network. A summary of representative experimental data and an update on the corresponding reaction mechanism will be presented.

References

[1] George H. Miley, "LENR Reactions Using Clusters", ICCF-18, Univ. of Missouri, Columbia, MO, 2013
[2] Lipson, A., Heuser, B. J., Castano, C., Miley, G. H., Lyakhov, B., and Mitin, A., "Transport and Magnetic Anomalies below 70°K in a Hydrogen-Cycled Pd Foil with a Thermally Grown Oxide," *Physics Review B.*, Vol. 72, 2005, p. 212507.
[3] Miley, G. H., and Yang, X., "Deuterium Cluster Target for Ultra-High Density," *18th Topical Meeting on the Technology of Fusion Energy*, San Francisco, CA, 2009.

Gas-Phase Nickel Hydrogen Experiments in Nickel Tubes in a Furnace

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laboratory study of Lattice Enabled (or Low Energy) Nuclear Reactions (LENR) has ated into two main kinds of experiments: (1) electrochemical loading of deuterons (D) heavy water into Pd (pioneered by Fleischmann and Pons) and (2) gas loading of protons nto Ni (started by Piantelli). The latter approach is widely thought to be the first method to mmercialized, and several small companies are now seeking to develop Ni and H gas phase generators. Leaders in this line of work include Rossi [1], Parkhomov [2] and Jiang[3].

st of the reported experiments, coils of resistive wire were wrapped around individual tubes ning Ni powder and the compound $LiAlH_4$, which decomposed to supply H gas. One such urnace was run at a time. We have taken an alternative approach of encapsulating the Ni r and $LiAlH_4$ in small metallic tubes, several of which can be put into a furnace and run aneously. We used circular nickel tubes with outside diameter of 6.5 mm, having 99.5% as bought from Goodfellow in the UK. This approach minimized the number of elements experiments at high concentrations, and also increased the availability of Ni, which is t by some to be the fuel for LENR. One end of 10 cm lengths of the Ni tubing was d and welded shut, loaded with 1 g of nickel powder and 0.1 g of $LiAlH_4$, evacuated and, crimped and welded at the other end. Melting of materials was the temperature indicator.

tions show that pressures exceeding 10 atmospheres, even at room temperature, would be by full decomposition of 0.1 g of $LiAlH_4$. Hence, our initial experiment was to measure e history of the pressure as the temperature of a resistively-heated furnace was raised to . An Omega PX309-500G5V 500 PSIG pressure transducer was used for that purpose. l perform experiments with various ratios of Ni to $LiAlH_4$ and different Ni powders. Our h makes it easy to try other sources of H, which do not contain Li, such as $NaAlH_4$ or That might be instructive, since Li has been proposed as the fuel in a recent paper by nd Rossi [4]. We have the ability to cut post-run Ni tubes along their axis to perform graphic and elemental analyses on the slag, and to search for energetic emissions.

evi *et al.*, "Observation of Abundant Heat Production from a Reactor Device and of Changes in the Fuel", ecat.com/wp-content/uploads/2014/10/ECAT-test-report-2014.pdf, 2014
. Parkhomov, "Investigation of the Heat Generator Similar to Rossi Reactor", Int'l. of Unconventional Science, Vol. 7, No. 3, pp. 68-72 (2015)
Qi *et al.*, "Anomalous heat production in hydrogen-loaded metals: Possible nuclear s occurring at normal temperature",
ive.google.com/open?id=0B5Pc25a4cOM2bV9DLUp1MTkwU1U
Cook and A. Rossi, "On the Nuclear Mechanisms Underlying the Heat Production by ", http://arxiv.org/abs/1504.01261 (2015)

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Nickel and Light Water Electrolysis Experiments

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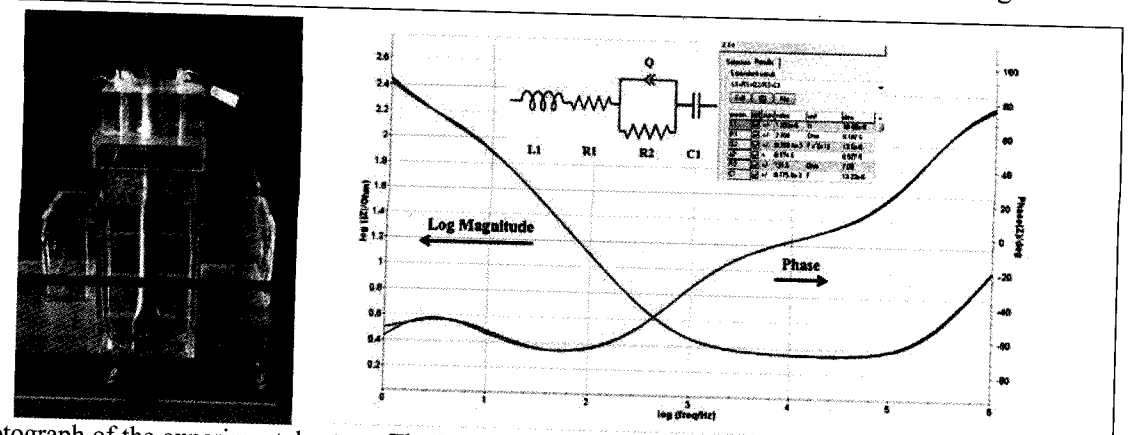
Most experiments on Lattice Enabled (or Low Energy) Nuclear Reactions have been done with either of two approaches: (a) electrolytic loading of deuterons from heavy water into Pd or other metals, the original Fleischmann-Pons method, or (b) gas phase interactions of protons from hydrogen gas with nickel or other materials, the method traceable back to Piantelli. There have been a few experiments on gas loading of deuterons onto Pd, and on electrolytic interaction of protons and nickel. The last of these combinations was pursued early in the field by a few researchers [1-4]. Given their reports of excess heat production in the experiments on electrolysis of light water with nickel cathodes, we sought to repeat such experiments.

Following the earlier work, we employed carbonate electrolytes of Li, Na, K and Rb, all at 0.5 M, except for the Li_2CO_3, which is limited by solubility to 0.08 M. 35 ml of the electrolytes were put into square Lucite cells 27 mm on a side. We used circular nickel tubes as cathodes with external diameter of 6.5 mm and wall thickness of 0.5 mm, having 99.5% purity as bought from Goodfellow in the UK. Four Pt wires parallel to the cathode tubes served as the anode. The cathodes were etched in 2:1 HNO_3:HCl prior to the runs. A BioLogic SP-300 unit was used to apply potentiostatic voltages of 1.5, 2.0, 2.5, 3.0, 3.5 and 4.0 V, and to perform current measurements and impedance spectroscopy. The setup is shown in the figure, along with a typical impedance spectrum from a cell with 0.5 M Na_2CO_3 run at 1.5 V. We computed the noise spectra from the cell currents, and fitted the Impedance Spectra with simulations of equivalent circuits. The thermal time constant for electrical heating of the electrolyte was about 30 min, as measured with a Type J thermocouple probe inside the cathode tube and coupled to it with thermal grease. We will report on SEM images, thermometry, current data and impedance results for the four electrolytes at various voltages.



Photograph of the experimental setup. The Pt anode wires are in the corners of the cell. Magnitude and Phase of one complex Impedance Spectrum (1 Hz to 6 MHz) as measured (blue and red curves) and simulated for the circuit shown (green and brown curves). Component Q is a Constant Phase Element.

[1] R. L. Mills and P. Kneizys, "Excess heat production by the electrolysis of an aqueous potassium carbonate electrolyte and the implications for cold fusion", Fusion Tech., Vol. 20, p. 65 (1991)
[2] V. C. Noninski, V.C. and C.I. Noninski, "Determination of the excess energy obtained during the electrolysis of heavy water", Fusion Technology, Vol. 19, p. 364 (1991)
[3] R. T. Bush, "A Light Water Excess Heat Reaction Suggests that 'Cold Fusion' May Be 'Alkali-Hydrogen Fusion'", Fusion Technology, Vol. 22, pp. 301-322 (1992).
[4] R. Natoya and M. Enyo, "Excess Heat Production in Electrolysis of Potassium Carbonate Solution with Nickel Electrodes" in "Frontiers of Cold Fusion", Universal Academic Press, Inc., Tokyo, pp. 421-426 (1993)

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Evidence for Nuclear Transmutations in Ni-H Electrolysis

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In this work the results of electrolysis experiments on Ni-H system is reported. An electrolytic cell with a Ni cathode and a Pt anode with a 1.0 molar K_2CO_3 aqueous (H_2O) solution as electrolyte was used for the experiment. Both the electrodes were in the shape of wires of 0.5 mm diameter and the electrolytic cell volume was about 1.5 liters. Separate glass piping was used to carry away the evolving H_2 and O_2 gases from the electrolytic cell to prevent any mixing.

A *dc*-power supply capable of supplying up to 5 A current was used to drive the electrolysis with the typical current being around 4 A. Doing the electrolysis at this current meant that a significant amount of heat was generated in the cell resulting in a relatively fast boil-off leading to water having to be replenished every three to four hours.

After running the electrolysis for a week with a daily run time of 7 hours on an average, a part of the nickel electrode, which by this time had become black, was taken for elemental analysis using Energy Dispersive Spectroscopy (EDS; also known as EDAX – Energy Dispersive Analysis of X-rays). The EDS analysis showed that a whole host of new elements had appeared on the cathode such as: K, Fe, Cu, O, Rh, Zr & Pb. The apparent concentration of the elements varied from just over a percent for K and Pb to about 10% for Rh and 20% for Cu.

The sample was then taken to a Time of Flight Secondary Ion Mass Spectrometer (ToF-SIMS) for isotopic analysis. Inadvertently the sample was cleaned with an emery paper to expose the shining nickel metal underneath before being analyzed in the ToF-SIMS machine. This analysis also showed that a set of new elements had appeared on the nickel wire which were: K, Si, Mg, Mn, Zn, O & Rh. The Ni itself was found to have the following isotopes: ^{58}Ni, ^{60}Ni & ^{62}Ni in the ratio 75:22:3.1 while the ratio of these isotopes in naturally occurring Ni is known to be 68:26:3.6 [1]. It is clear that in the electrolyzed Ni the concentrations of ^{60}Ni and ^{62}Ni have gone down while the concentration of ^{58}Ni has increased. This is a clear indication that nuclear reactions have taken place during electrolysis.

References:

[1]K. J. R. Rosman & P. D. P. Taylor, "Atomic weights of the elements 1997", Pure & Appl. Chem., **71**, p1593-1607, 1999.

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Cold Fusion Will Lower the Cost of both Energy and Equipment

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Cold fusion will lower the cost of energy because the fuel costs nothing. It will also greatly reduce the cost of many machines, especially electric generators. The cost of generators is likely to fall by a factor of 200, from $2,000/kW to $10/kW, which is the cost difference between a power company central generator and a portable gasoline generator.

A radical reduction in the cost of one device does not always reduce the cost of others. Since 1900, the cost of illumination has fallen by a factor of 80, but this has not directly reduced the cost of other goods and services by a similar factor. Since 1970, the cost of computer memory has fallen by a factor of 10^8. Microprocessors and cheap memory enhanced many products. They brought us the Internet and ubiquitous cheap computing. But so far they have not drastically lowered costs outside of computer applications. Cold fusion is different. All machines use energy, so cold fusion will lower the cost of everything, but it will have the biggest impact replacing large, expensive machines with small mass-produced versions. Other new sources of energy such as solar panels also have zero cost fuel, but they will not reduce the cost of other machines. Only cold fusion can do this.

It follows that the most profitable use of cold fusion in the first decades after it is introduced will be to replace existing technology, rather than to make radical new technology. Microprocessors brought us machines we did not have, such as cell phones and the Internet. Cold fusion will — at first — dramatically lower the cost of machines we already have.

X-ray, neutron, and charged particle emission under X-ray irradiation of deuterated structures

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s investigated the emission of X-rays, neutrons, and charged particles during irradiation rated structures by X-ray beam. The targets (deuterated CVD-diamond, palladium, nium and titanium) were irradiated using of X-ray tube equipped with a lens.

ave used different types of detectors: a multi-channel detector based on He-3 counters, c track detector CR-39 and silicon surface barrier detectors. We have found the emission of ons with energies above 10 MeV, and the emission of alpha particles in the energy range 7- eV. This result provides guidance on the possibility of stimulating of multi-particle fusion ons of deuterium nuclei in solid deuterated structures.

Anomalous Heat Effects by Interaction of Nano-Metals and H(D)-Gas

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Brief review of Technova-Kobe study (2008-2015) on anomalous heat effects (AHE) by interaction of nano-metals and D(H)-gas is presented.

Part-I) D(H) isotopic effect by twin gas loading and calorimetry is reviewed [1]

Part-II) AHE by interaction of binary Ni-based nano-metals and H(D)-gas is reviewed [2-5]

Part-III) Theoretical modeling is briefly reviewed [5].

Anomalous Heat Power Data have been obtained by Ni-based binary nano-metals at 200-300 deg C range, as concluded in the following:

1) AHE lasting for several days has been observed at elevated temperatures in the range of 200-300 deg C.
2) AHE has been confirmed by repeated observation of excess heat-power
3) AHE was lasting for long time span as several days for CNS, PNZ and CNZ samples.
4) AHE has been seen after D(H) loading ratios saturated.
5) AHE is therefore some surface sited effect by in/out of D(H)-gas.
6) Observed long lasting heat gave order of GJ/mol-H (or several keV/atom-H) in a few days span.
7) Level is not H(D) chemical absorption energy, so far.
8) AHE at 200-300 deg C is impossible to explain by known chemical reactions.
9) Pd-only nano-metals did not work at higher temperatures than 100 deg C.

[1] A. Takahashi, et al: Mesoscopic catalyst and D-cluster fusion, Proc. JCF-11, pp.47-52, see also http://vixra.org/author/akito_takahashi [4] and [5]

[2] A. Takahashi, et al: JCMNS Vol.15, pp. 23-32

[3] A. Kitamura, et al. : Proc. ICCF19 (to be published in JCMNS)

[4] A. Kitamura, et al.: Proc. JCF-16 (to be published)

[5] http://vixra.org/author/akito_takahashi (1)-(15) of the compilation

(Advanced joint-team work by NEDO-MHE will be presented elsewhere at ICCF20 Conference, Sendai, Oct. 2-7, 2016)

Controlled Electron Capture: Enhanced Stimulation and Calorimetry Methods

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The Controlled Electron Capture (CEC) method[1] has been described[2] earlier for use in a pressurized, H_2O-based electrolysis system utilizing a Ni wire cathode. Excess power was seen and could be controlled by modifications to the stimulation pulse shape, width, repetition rate an amplitude. This excess could be turned on and off by manipulating these parameters at constant pulse power.

This technology has been extended to use faster rise and fall time pulses, hydrogen isotope gas based systems, at higher temperatures, and more precise and accurate calorimetry. Our IPB cell/calorimeter is operated as a isothermal compensation type calorimeter. The IPB cell/calorimeter is shown in Figure 1. Potential sources of error in this system will be discussed as well the methods used to minimize them. In power compensation mode the cell is held at constant temperature using a heat power feedback system as constant power pulses are added to the system, resulting in a reduction of heater power. That power reduction is one of the components used to calculate the output power. Other parameters used in the calorimetric calculation will be discussed.

The IPB cell/calorimeter was stimulated by commanding different pulse widths at constant amplitude with the pulse power held constant by appropriately varying the pulse repetition rate. An example of the pulse width sequence is shown in Figure 2. At 250°C the ratio of output power increase to input pulse power varied from 1.0 to over 2.0 depending on the pulse width at constant input power. That ratio was always 1.0 at all pulse widths attempted at 600°C. These results have been seen tens of times. The amount of excess power was also dependent on the composition of the gas, and the metal alloy coatings on the core. The outer layer of the core was always pure Ni. The composition of a multilayer metal-dielectric-metal coated core was chosen to allow for reasonable hydrogen solubility and mobility at 300°C. These and the results of other ongoing experiments will be presented.

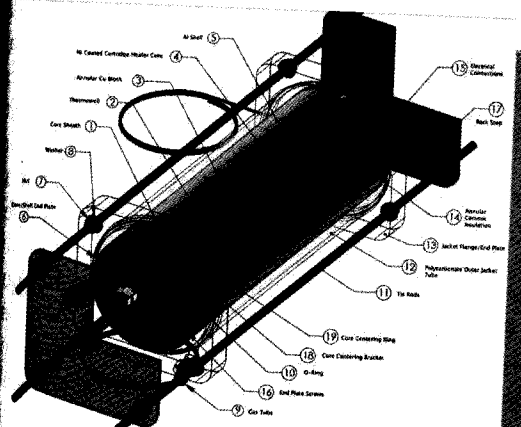

Figure 1. Isoperibolic calorimeter

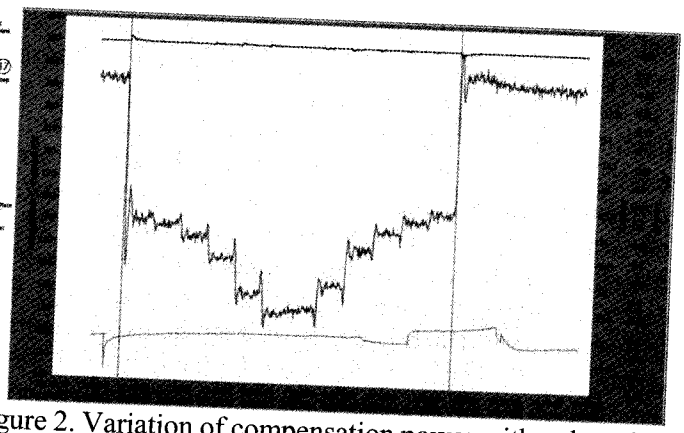

Figure 2. Variation of compensation power with pulse width

[1] R. Godes, "Drive circuit and method for semiconductor devices", US Patent 8,624,636, 2014
[2] R. Godes, R. George, F. Tanzella, M. McKubre, "Controlled Electron Capture and the Path to Commercialization" J. Condensed Matter Nucl. Sci, vol. 13, pp. 127-137, 2014.

A study on the excess heat generation in Ni-H gas discharge systems

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Defkalion Green Technologies (DGT) demonstrated the excess heat in the Ni-H gas discharge systems in 2013[1]. To confirm this interesting phenomenon, we constructed two gas discharge systems using nickel and hydrogen. In the spark plug cell, we investigated the heat effect at different pressures and temperatures, but no excess heat was observed. In the high voltage electrode cell, in several experiments we observed about 20 Watts excess heat when the cell was exposed to H_2 gas at a pressure of 0.2 MPa, which is about 14% of the input power; we also used the deuterium instead of hydrogen, then observed the heat after death. However, we cannot reproduce these phenomena. The more experiments have been performed and will be discussed in details.

[1] Y. E. Kim, J. Hadjichristos, "Theoretical Analysis and Reaction Mechanisms for Experimental Results of Hydrogen-Nickel Systems", ICCF-18, Columbia, Missouri, 2013.

A study on Ni-H high-temperature devices

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In 2014 Levi et al. tested the Andrea Rossi's LENR reactor (E-Cat), and then reported that the reactor produced more energy than it consumed. An interesting result they also found is that ^{7}Li content was reduced in the ash which was revealed by both the SIMS and the ICP-MS methods [1]. After that, there have several groups trying to confirm this result. Some interesting phenomena were reported by some scientists, such as A.G. Parkhomov [2], MFMP [3] and Songsheng Jiang [4] and so on.

We have also designed a reactor using $LiAlH_4$ and nickel (or nickel alloy), in some experiments we also added lithium metal to the fuel. Compared with dummy reactor that without internal charge, no any anomalous heat was found in all experiments. However, when we studied the isotopic composition of the fuel before and after the burning by means of ICP-MS. In some experiments, an isotope shift was found in lithium, but the isotope of nickel does not change obviously, as shown below. The more detailed analysis will be discussed.

ICP-MS result of fuel and part of samples

	^{6}Li	^{7}Li	^{58}Ni	^{60}Ni	^{61}Ni	^{62}Ni	^{64}Ni
Natural abundance	7.59	92.41	26.22	68.08	1.14	3.63	0.93
Fuel	7.46	92.54	26.17	68.06	1.16	3.66	0.95
Sample #1ash	8.62	91.38	26.38	67.86	1.16	3.66	0.94
Sample #2 ash	12.35	87.65	26.01	68.21	1.14	3.60	1.05
Sample #3 ash	8.26	91.74	25.95	68.36	1.14	3.60	0.95
Sample #4 ash	7.48	92.52	26.11	68.15	1.14	3.64	0.95
Sample #5 ash	7.60	92.40	26.10	68.15	1.16	3.64	0.96
Sample #6 ash	7.72	92.28	26.27	68.02	1.16	3.64	0.90

[1]. Levi, G., Foschi, E., Höistad, B., Pettersson, R., Tegnér, L., Essén, H., "Observation of abundant heat production from a reactor device".
http://www.sifferkoll.se/sifferkoll/wp-content/uploads/2014/10/LuganoReportSubmit.pdf. 2014
[2]. Parkhomov, A. G., "Investigation of the heat generator similar to Rossi reactor". *International Journal of Unconventional Science[J], 3* (7), pp. 68-72, 2015
[3]. MFMP, *GlowStick* 5.2,
http://www.quantumheat.org/index.php/en/home/mfmp-blog/515-glowstick-5-2. 2015
[4]. Bu-Jia Qi, Ming He, Shao-Yong Wu, Qing-Zhang Zhao, Xiao-Ming Wang, Yi-Jun Pang, Xian-Lin Yang and Song-Sheng Jiang, "Anomalous heat production in hydrogen-loaded metals: Possible nuclear reactions occurring at normal temperature".
http://www.lenr.com.cn/index.php?m=content&c=index&a=show&catid=13&id=91.2016.

Biotransmutation of Cs^{133} and Biodeactivation of Cs^{137} by Aerobic Microorganisms of Methanogenic Sea Ooze

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In the work the processes of effective transmutation [1-4] of both stable Cs^{133} and radioactive Cs^{137} isotopes to Ba isotopes during the growth of biological substance (aerobic microorganisms of methanogenic sea ooze) in water solutions of cesium salts are presented and discussed. For satisfaction of aerobic conditions long-term air sparing of water solutions was used. The metabolic process in biological substance during transmutation was controlled by PH analysis and corrected by glucose addition. The high probability of these reactions is connected with the formation of coherent correlated states of protons in non-stationary potential nano-wells in growth zones of biological substance [5].

a) ***Analysis of stable Cs^{133} isotope transmutation.***

The expected reaction of stable Cs^{133} isotope transmutation is the following $Cs^{133} + p = Ba^{134}$ [1-4].

Aqueous (H_2O) solution of cesium nitrate $Cs^{133}NO_3$ with concentration ~210 mg/L for Cs^{133} was used. Cultivation of the microorganisms was carried out during 24, 48, 144, 192 h under aerobic conditions in closed flasks in the aqueous nutrient medium containing biological substance and necessary salts and carbon. Analysis of Cs^{133} ions content was carried out by flame emission spectroscopy (atomic-absorption spectrophotometer AA 350 was used). The content of Ba^{134} ions was examined on the optical emission ICP spectrometer "Prodigy" with inductively connected plasma.

The experimental rate of Cs^{133} transmutation was the following:

$\left\{dN_{Cs^{133}}(t)/dt\right\}/N_{Cs^{133}}(t) \approx (0.8...2.0)$ (transmutated Cs^{133} nuclei per s and per Cs^{133} nucleus).

Average concentration of Cs^{133} in 192 h decreased by 56%.

b) ***Analysis of radioactive Cs^{137} isotope transmutation and deactivation.***

Experiments on Cs^{137} isotope transmutation (deactivation) in reaction $Cs^{137} + p = Ba^{138}$ [3-4] with formation of stable Ba^{138} isotope were performed during 28 days under aerobic conditions on the base of light water solution of similar (but radioactive) $Cs^{137}NO_3$ salt with the presence of the same biological substance, salts and carbon. In the control flasks the biological substance was absent. Initial (at t=0) activity of water solution was ~10^4 bk/flask. Radiospectroscopic measurements were performed on the device "Inspetor 100" (*NaI* scintillation detector with a diameter of 50 mm was used). Decrease of resulting averaged gamma-activity (energy 661.65 keV) of Cs^{137} in closed flasks was about 22% during 12 days of cultivation (in some flasks decreased by 43% and even 70%) and it is connected with the transmutation to stable Ba^{138}. Increase of Ba^{138} also was observed. In control flacks activity changes corresponded to spontaneous decay and was close to statistical error.

[1]. V.I. Vysotskii, A.A.Kornilova. *Nuclear fusion and transmutation of isotopes in biological systems*, Moscow, "MIR" Publishing House, 2003.
[2]. V.I. Vysotskii, A.A.Kornilova. *Nuclear transmutation of stable and radioactive isotopes in biological systems*, India, Pentagon Press, 2009.
[3]. V.I. Vysotskii, A.A.Kornilova. Transmutation of stable isotopes and deactivation of radioactive waste in growing biological systems. Annals of Nuclear energy, v.62, p.626-633, 2013.
[4]. V.I. Vysotskii, A.A.Kornilova. Microbial Transmutation of Cs-137 and LENR in growing biological systems Current Science, v.108, No.4, p. 142-146, 2015.
[5]. V.I. Vysotskii, M.V.Vysotskyy. Coherent correlated states and low-energy nuclear reactions in non stationary systems. European Phys. Journal. A , v.49, issue 8: 99, p.1-12, 2013.