

OPERATING THE LENT-1 TRANSMUTATION REACTOR: A PRELIMINARY REPORT

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ABSTRACT

The Low-Energy Nuclear Transmutation (LENT-1) reactor can transmute thorium into smaller mass elements. This transmutation process differs markedly from the natural decay of thorium-232 into lead-208. Using a small amount of thorium nitrate dissolved in distilled water as the electrolyte, the LENT-1 reactor will transmute essentially all of the thorium into small mass elements in thirty minutes processing time. Considerable development work is required to understand the role of reactor parameters in producing various transmuted smaller mass elements.

A. INTRODUCTION

Most of the current models of nuclear reactions require that high energy be used to cause nuclear reactions, except for the decay of naturally radioactive substances such as thorium and uranium. Nearly all of the nuclear experimental data has been obtained by experiments based on nuclear reactors or using high energy particle accelerators. The study of nuclear reactions in or on the surface of a metal lattice is relatively new. Two international conferences on Low-Energy Nuclear Reactions have been held and the proceedings published in the *Journal of New Energy* [1,2]. Several important papers have reported on experiments in which low-energy nuclear reactions are observed. This paper reports on the results that have been achieved by various workers using the Low-Energy Nuclear Transmutation (LENT-1) reactor.

The LENT-1 reactor consists of a cylindrical electrode and a disk-shaped electrode positioned on the interior of the cylindrical electrode. See Fig. 1 for an outline drawing of the LENT-1 reactor. Both electrodes are made of a special metal (e.g. zirconium). The reactor includes strong stainless steel end plates and bolts together with Teflon™ seals [Editor's Note: See detailed description in *Infinite Energy*, Vol.3, issue #13/14.]. When properly assembled, the reactor is a pressure vessel capable of processing about 20 to 30 ml of solution. Some of the variable parameters are the following:

- Pressure
- Temperature
- Electric Potential
- Electric Current
- Input Electrical Power Waveform (d.c., a.c., pulsing, etc.)
- Electrical Parameter Changes During Processing
- Electrolyte Conductivity
- Processing Time
- Electrode Conditioning

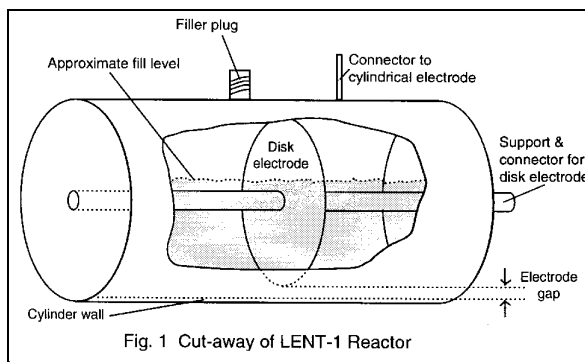


Fig. 1 Cut-away of LENT-1 Reactor

In laboratory experiments over the past three years, the following parameter ranges have been selected or observed: Pressure from 1 to 25 atmospheres; Temperatures from 70°F to 400° F; Electric potential from 25 to 600 volts; Electric current up to 5 amperes; Waveforms normally either a.c. or d.c.; Electrolyte resistance from 2 to 500 ohms; Processing time from 30 minutes to six hours; and a variety of electrode conditioning, usually by anodizing to obtain a high-resistance oxide layer. Experimental results vary widely with changes in parameters. Over three years of experimentation has resulted in useful operating protocols that are highly reproducible in terms of transmuting thorium-232 into lower-mass elements. Elements and amounts of elements produced by transmutation vary significantly from one experiment to another. However, it is expected that exact control of operating parameters will produce essentially the same transmutation results in terms of elements transmuted and amounts of such elements produced.

Low-energy nuclear reactions constitute a new and potentially highly-valuable branch of physics. The theory must follow the experimental results as there are no

widely recognized theories that explain all of the experimental observations. This branch of physics is new and will be met with a high degree of skepticism by many physicists. Moderate skepticism is acceptable and expected for all dramatic new discoveries. Excessive skepticism or denial of replicated experimental results by proclaimed authorities must be treated in the same manner as previous declarations against heavier-than-air machines, atomic energy, data processing by machines, and space flight. All of these new discoveries were condemned by self-proclaimed experts.

Replication of experiments with the LENT-1 reactor have been performed by several different groups. Where the protocols are precisely observed, thorium is transmuted into other elements within a thirty-minute processing period. The following is an excellent definition of a scientific fact: "A scientific fact is the close agreement of a series of observations of the same phenomena." With this definition, it can now be stated that low-energy transmutation using the LENT-1 is a scientific fact. However, workers in this new technology will welcome published reports on further replications or for experimental additions to the currently-available experimental data. The purpose of this paper is to provide additional information obtained from a series of recent (September-October 1997) multiple experiments (over a dozen) using the LENT-1 reactor. In addition, this paper provides some important tutorial information.

B. THE USE OF THORIUM NITRATE WITH LENT-1

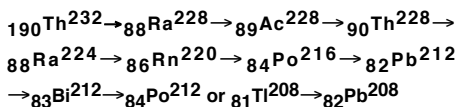
The element thorium has 26 known isotopes, none of which are stable. However, Thorium-232 is the isotope of thorium that is found in nature. This **almost stable** isotope has a half life (the time it takes for one half of the element to transmute into other elements) of 1.4×10^{10} years or 14,000,000,000 years. Although this thorium isotope is considered to be radioactive, it is only mildly radioactive and can be used in normal laboratories without having to operate under the regulations of the Nuclear Regulatory Agency that are pre-

scribed for handling higher-level radioactive materials.

Thorium nitrate has the chemical compound symbols of $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$. It is labeled by the supplier as Radioactive and Oxidizer. Class 7 (Primary Risk) and Class 5.1 (Secondary Risk). 1 Type A Package x 1.2×10^{-5} Curie. Cargo Only Aircraft! This compound is available from Johnson Matthey, Precious Metals Division, 2001 Nolte Drive, West Deptford, NJ 08066. (609)384-7000. Fax (609)384-7282.

Thorium nitrate is readily soluble in water. For careful experiments, only distilled water should be used if you intend to make **before-** and **after-processing** measurements of elements with a parts-per-million accuracy. Water that is not distilled may carry various elements in parts per million quantities that will distract from the accuracy of determining what elements are being produced during transmutation experiments.

Thorium Nitrate, $\text{Th}(\text{NO}_3)_4 \cdot 4\text{H}_2\text{O}$, was chosen for testing with the LENT-1 Kit because it is **very soluble** in water. Thorium, in nature, consists of about 100% ${}_{90}\text{Th}^{232}$ which is mildly radioactive with a half life of 1.4×10^{10} years. The entire chain of transmutation events in the natural radioactive decay of thorium is:



If the thorium nitrate were absolutely 100% pure and freshly constituted from chemically-pure thorium, one could assume that there would be no decay products. However, the radioactive decay products are continuously produced by the radioactive decay of thorium. The amount of each daughter product in a prepared sample is a function of previous purity of the thorium and the shelf life of the product. The following table provides information on half-lives, decay modes, and energies of emitted particles in the thorium decay series:

TABLE I. THORIUM DECAY DAUGHTER PRODUCTS

| Element | Half-Life | α (MeV) | β (MeV) | γ (KeV) |
|--------------|------------------------------|----------------|-------------------|-------------------|
| Thorium-232 | $1.4 \times 10^{10}\text{y}$ | 4.01, 3.95 | -- | 59 (w) |
| Radium-228 | 5.76 y | -- | .039, .015 | 14 (w) |
| Actinium-228 | 6.15 h | -- | 1.2, 2.1 | 911, 969, 338 |
| Thorium-228 | 1.91 y | 5.42, 5.34 | -- | 84, 216, 132, 166 |
| Radium-224 | 3.66 d | 5.69, 5.45 | -- | 240 |
| Radon-220 | 55.6 s | 6.29 | -- | 550 |
| Polonium-216 | 0.145 s | 6.78 | -- | 805 (w) |
| Lead-212 | 10.6 h | -- | .331, .569 | 239, 300 |
| Bismuth-212 | 60.6 m | 6.05 | 2.25 | 40, 727 |
| Polonium-212 | 298 ns | 8.78 | -- | -- |
| Thallium-208 | 3.05 m | -- | 1.8, 1.28, & 1.52 | 2615, 583, 511 |
| Lead-208 | stable | | | |

SOURCES: Lapp et al., [3], Hunt [4].

RADIOACTIVE DECAY PRODUCTS

When a thorium nucleus decays (transmutes into another element) the general process is for the Thorium-232 to emit an **alpha particle** (essentially an ionized helium-4 nucleus). This alpha particle emission is accompanied by the emission of a **gamma ray**. The gamma ray has a specific energy level of 59 Kev or 59,000 electron volts. A gamma ray is an energetic photon —quantized energetic electromagnetic radiation. Note that in the above table, seven of the transmutation events emit alpha particles and five emit beta particles (essentially the emission of an energetic electron). Note also that all of the transmutation events in the natural decay of thorium emit gamma rays except for polonium-212.

One can purchase various types of sensors that will measure alpha, beta, and gamma emissions. **It is important to note that naturally radioactive thorium will emit all three: alphas, betas, and gammas.** It is also important to understand that the natural radioactive decay of thorium (and of uranium) is a process that gives off energy carried by the kinetic energy of the daughter elements and by the alpha, beta, and gamma radiation. However, this is not the process that occurs in the artificial transmutation of thorium in the LENT-1 reactor! The nuclear processes in the LENT-1 reactor are **not** an increase in the natural decay rate of thorium. The normal chain of radioactive decay of thorium will continue, of course, in the reactor as the thorium is being processed. This normal radioactive decay will continue with any thorium remaining after the processing by the LENT-1 reactor. If operated by the established protocols, there will be only a very small amount of thorium remaining after the standard thirty minutes of processing time.

The type of nuclear reaction that is believed to take place in the LENT-1 reactor is a process by which one or more protons (ionized hydrogen obtained from the water — H_2O) are injected into the nuclei of the thorium atoms **which have been**

transported onto or close to the surface of one of the electrodes in the reactor.

Normally these reactions take place on the cathode, however, where a.c. is used it is expected that these reactions take place during the cycle when each electrode is temporarily the cathode. The addition of one or more protons to a thorium nucleus causes the nucleus to become immediately unstable. By fusion of the proton and thorium, protactinium-233 can be produced. Pa-233 decays to U-233 and the U-233 decays by alpha emission to Th-228 which decays by alpha emission to Ra-224 etc. However, it is more likely that the thorium will fission due to the sudden instability by being injected with one or more protons. This disruption of the stability of the thorium nucleus can produce fission of the nucleus into two or more other elements. While the natural decay of thorium ends up as a stable lead isotope (Pb-208, the predominant isotope of lead found in nature), it is expected that the fission of thorium will be into elemental masses that are considerably less massive than lead. As an example, if the thorium were to be injected with 2 protons, the thorium could split into two equal parts, then one would expect to get two nuclei of palladium. More often unequal fission products are expected. Because heavy elements like thorium are **neutron rich** (having a higher ratio of neutrons to protons as compared to the lower mass elements), some unstable isotopes of palladium may be expected (such as Pd-117). These isotopes generally have short half lives and decay into other elements such as silver, cadmium, indium, or tin by beta emission. The beta emission process occurs as a neutron in the nucleus emits an electron and becomes a proton. This is one way that the excess neutrons are consumed. An alternative would be the release of neutrons. Fortunately, the nuclear reactions that are observed are beta emissions rather than the emission of neutrons.

Nuclear reactions are complex but not complicated. A study of a chart of the nuclides will show that unstable elements below the mass of lead will normally decay (transmute) into other elements by beta decay. Therefore, the newly-produced element has one less neutron and one more proton. The study of nuclear radiation (often resulting from studies of the results of nuclear reactions in the fuel pellets in a nuclear power plant) has produced a great deal of information as to what elements are produced from the fissioning of uranium. In general, nearly all of the elements produced by the fissioning of heavy elements (such as U-235) are either stable or are radioactive and exhibit further transmutation by **beta decay!** However, the

natural radioactive decay events often produce alpha particles. Those who proclaim that the LENT-1 reactor must produce neutrons need to be aware of the extensive experimental evidence, especially with reactors of the class of the LENT-1.

It is true that heavy elements are **neutron rich**, that is, these heavy elements have a higher ratio of neutrons to protons as compared with lower-mass elements. **However, these neutrons do not have to be emitted under nuclear fission processes.** Nature has decreed that these excess neutrons can be transmuted into protons in the nucleus by the emission of electrons. The end result is important in the determination of the transmutation results in the LENT-1 reactor. Please note that the elements produced by transmutation in the LENT-1 reactor are not always expected to be stable elements. The experimental evidence is that immediately after the processing of thorium in the LENT-1 reactor, one or both of the reactor electrodes are radioactive (meaning that the electrodes emit some combination of alpha, beta, and gamma emissions).

In the processing of the thorium-laden electrolyte, the measurements of emission

barrier of a few sheets of paper. Using an alpha sensor (detector) and a beta sensor (detector) the thorium emissions will have both alpha and beta emissions. The expected nuclear fission products that cause the electrodes to become radioactive are expected to produce mainly beta emissions. (However, if the thorium and the daughters are not totally transmuted to low-mass isotopes, or the thorium and a proton fuse into protactinium (Pa^{233}) and which decays into lower mass isotopes, then there can be emissions of $\alpha, \beta,$ and $\gamma.$)

TEST 2. The naturally radioactive thorium has a very long half life of about 14 billion years. If the radioactive emissions from the electrode are due solely to thorium being plated onto the electrode, the degree of radioactivity from the electrode will not change with time over a few days or even a few years. **If the radioactive emissions from the electrode are due to beta decay, then it is expected that these emissions will decrease with time of a few hours to a few days.** Depending on the elements being produced by transmutation in the LENT-1 reactor, the half-life of these elements (beta emitters) will be a combination of the various elements pro-

duced which has a half life of 298 nanoseconds. **The assumption is made that the total emission of gamma rays is an acceptable measure of the amount of radiation in a sample prior to processing. It is further assumed that the same gamma-ray total emissions after processing is an acceptable measure of radioactivity.** If we observe an experimental procedure in which the radiation of container, electrodes, and gaseous effluent (if any) are the same before and after processing, then we assume that the changes in radioactivity of the electrolyte is an appropriate measure of the before and after amount of radioactivity. (Often, the short-term radioactivity of the electrodes has decreased to near background by the time that samples are processed by local chemical laboratories.) You may want to submit samples of **before-processing** and **after-processing** to laboratories with suitable gamma-ray spectrometers. Each element emits gamma rays having different energy levels. By using instrumentation that can measure the various energy levels one can determine what elements are present. Such equipment, if properly calibrated and operated, can be used to determine which elements are present in the **before-** and **after-processing** samples.

The gamma-ray spectrometer can be used immediately after processing to observe the emissions from the electrodes. If the spectrometer is sufficiently sensitive it will be possible to determine exactly which isotopes are decaying by beta decay. A complete low-cost spectrometer can consist of a sodium iodide detector, a power supply, a multi-channel analyzer (mounted on printed-circuit boards that go into a personal computer) and the proper computer software. Such equipment can be obtained for about \$5,000. This type of equipment will be very helpful for the LENT-1 experimenter. For better spectrometers, cryogenic cooling and vacuum systems are required. These features add an estimated \$15,000 to the spectrometer.

If the LENT-1 reactor is properly used, the entire thirty-minute process is operated within a sealed reactor so that no gaseous effluent is released during processing. However, there may be some gaseous elements such as helium, argon, chlorine, etc. that may be a by-product of some nuclear transmutations. Such gases may be released when removing the filler plug from the reactor. There is no expectation that any thorium would be lost with the release of such a gaseous effluent. Using suitable professional laboratory equipment (such as a gamma-ray spectrometer), the electrodes can be examined to determine what elements are present on the elec-

TABLE II. Before & After Geiger Counter Readings from Electrolyte
Table Data in Counter per Minute

| | Sample B | Sample C | Sample D | Sample E |
|--------------------|------------|------------|------------|------------|
| Before Processing* | 39 ± 17 | 43 ± 17 | 41 ± 17 | 41 ± 17 |
| After Processing | Background | Background | Background | Background |

* Counts after subtracting background.

made using a Geiger counter are as shown in the following table:

Those who are somewhat knowledgeable in electrochemistry would immediately declare that the thorium has been removed from solution and plated out of solution onto the electrodes. This concept is not unreasonable. However, alternating current, as used with the specific protocols for the operation of the LENT-1 reactor is not expected to be effective in plating thorium onto the reactor electrodes. **Here is how to measure whether the thorium has plated onto the electrodes:**

TEST 1. The naturally radioactive thorium emits alpha and gamma particles. The daughter products emit alpha, beta, and gamma radiation. The lower-mass fission products from thorium produced in the LENT-1 reactor are expected to be stable or only emit beta active isotopes, if the thorium is totally transmuted to the low-mass isotopes. Because of the large size of the alpha particles (a helium-4 nucleus consisting of two neutrons and two protons) any emitted alpha particles can be stopped by one to a few sheets of paper. The smaller beta particles (essentially energetic electrons) can penetrate the

produced. In some of the experiments that have been done, the average time for the reduction of the beta emission from the electrode **after processing** ranges from an estimated 25 hours to 100 hours. This rapid decrease in radioactivity cannot be due to the plating of thorium onto the electrodes. See Fig. 4.

Because of the large number of parameters that can have different values, there may be cases where thorium is plated onto the electrodes. There may be cases where there is a combination of plating and nuclear reduction of thorium. And there may be cases where protactinium is produced with its resultant alpha particle emission. The above tests will help to determine to what extent the thorium is present on the electrodes. However, to determine just what elements are on the electrode(s) gamma-ray spectroscopy can be used.

C. GAMMA-RAY SPECTROSCOPY

The use of gamma-ray spectroscopy is an appropriate choice of instrumentation to use with these experiments because all of the daughter products of thorium emit gamma rays except for polonium-212

trode itself. Only a small amount of thorium has been determined to be a part of the eroded electrode that is the result of running a thirty-minute experiment.

In LENT investigation the most important measurement may be EDX (Energy Dispersive X-ray Spectroscopy) or ICP/MS (Inductively Coupled Plasma/Mass Spectrometry) analysis combined with SIMS (Secondary Ion Mass Spectrometry), and with AES (Auger Electron Spectroscopy) for determination of elements and their isotopes.

D. PRELIMINARY DATA FROM EXPERIMENTS

The LENT-1 reactor was used with a variable power supply in efforts to replicate the experimental results of the transmutation of thorium. The basic experimental equipment used was a power supply which allows for the selection of either a.c. or d.c. power from ten to five hundred volts. These particular experiments used the LENT-1 reactor obtained from the Cincinnati Group; the power supply; and a computer-acquisition system for counting and storing data from a Geiger Counter. The entire equipment used for these experiments cost less than \$5,000 including \$3,000 attributed to the cost of the LENT-1 Kit. Therefore, even small companies can participate in the development of this new technology.

The LENT-1 reactor consists of a cylindrical electrode with a disk-shaped inner electrode so that the electrical current flows from the disk to the inside of the cylindrical electrode. The plane of the circular-disk electrode is perpendicular to the axis of the cylindrical electrode. The reactor is operated with the axis of the cylindrical electrode parallel to the laboratory bench top. The reactor is filled about half full of a mixture of thorium nitrate and distilled water. See Fig. 1 for an outline drawing of the reactor.

The resistance of this special electrolytic cell is a function of the amount of thorium nitrate, the spacing between the disk electrode and the cylindrical electrode, the temperature of the electrolyte, and the chemical changes that are caused in the electrolyte during processing. The resistance of the cell changes dramatically, as computed by the voltage divided by the current, during the processing time. Fig. 2 shows a plot of the cell resistance (and cell temperature) with processing time.

At the initiation of the processing of the thorium solution, about 100 watts of power is introduced into the reactor. This power input causes a gradual rise in temperature of the reactor as measured by a digital thermometer with a surface sensor affixed to the outside of the cylindrical electrode of

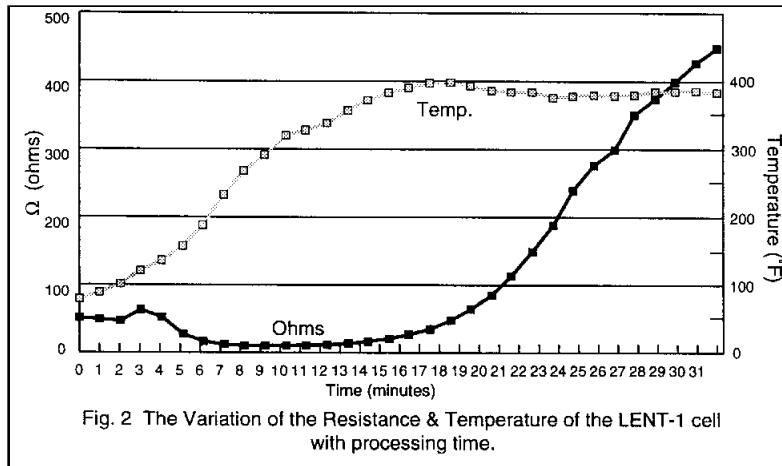


Fig. 2 The Variation of the Resistance & Temperature of the LENT-1 cell with processing time.

the reactor. Following the prescribed protocols provided with the LENT-1 Kit, the voltage is increased by ten-volt steps as the current decreases (the internal resistance of the electrolyte increases). Therefore, the experiments are operated using an approximately constant power input. After about fifteen minutes of operation the temperature of the electrolyte stabilizes at about 375°F ± 50° F. One may expect that the nuclear reactions would cause an extreme amount of heat to be produced. However, the complexity of nuclear reactions that appear to be present can be a combination of exothermic (heat producing) and endothermic (heat using) reactions.

From about fifteen to thirty minutes of the processing time, the resistance of the electrolytic cell strongly increases. This experi-

of operation. In one experiment, the cell was operated for an additional thirty minutes. The voltage was controlled to keep the temperature of the reactor about constant (as a safety precaution). The result was that a continuous 80 watts of electrical power was fed into the cell. Both temperature and cell resistance remained essentially constant. The explanation is that the cell, at temperatures near 400° F, is radiating all of the 80 watts of input power. This measurement is important for our evaluation of where the input energy is being used and as a basis for a later determination of the amount of energy it takes to drive the desired nuclear reactions.

As inferred by the temperature of the reactor, the internal pressure of the cell ranges from atmospheric pressure at the start to as high as more than twenty

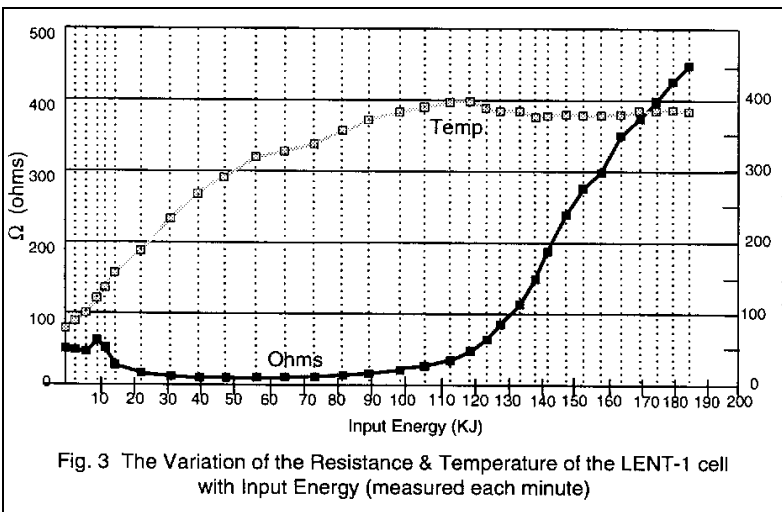


Fig. 3 The Variation of the Resistance & Temperature of the LENT-1 cell with Input Energy (measured each minute)

mental measurement suggests that the thorium ions are being removed from solution faster than other chemical ions are added to the solution. The data from the same experiment as shown in Fig. 2 has been plotted against the input energy to the reactor. See Fig. 3. There is a noticeable difference between the curves in the two figures 2 and 3. Both the temperature rise curve and the rise in the cell resistance, when plotted against total energy

input, have portions that are relatively linear. This observation suggests that, as expected, the temperature of the cell is roughly a linear function of the input energy for the first ten minutes of operation. Also, the rapid increase in cell resistance is quite linear after about 20 minutes

of operation. In one experiment, the cell was operated for an additional thirty minutes. The voltage was controlled to keep the temperature of the reactor about constant (as a safety precaution). The result was that a continuous 80 watts of electrical power was fed into the cell. Both temperature and cell resistance remained essentially constant. The explanation is that the cell, at temperatures near 400° F, is radiating all of the 80 watts of input power. This measurement is important for our evaluation of where the input energy is being used and as a basis for a later determination of the amount of energy it takes to drive the desired nuclear reactions.

As inferred by the temperature of the reactor, the internal pressure of the cell ranges from atmospheric pressure at the start to as high as more than twenty atmospheres (about 0 to 400 psig). If proper assembly and operation of the cell has taken place, the steam produced from the heating of the electrolyte is contained within the cell. Note: due to the possibility of the generation of very high pressures, this experimental

apparatus should be placed behind a barrier in the case of any fracture of the reactor! **THIS IS NOT A TOY AND SHOULD BE USED ONLY BY SAFETY -AWARE TRAINED EXPERIMENTERS.**

BEFORE & AFTER RESULTS

The electrolyte, the disk electrode, and the inner surface of the cylindrical electrode were measured for radioactive emanations by using a Geiger counter. The

before-processing measurements of the electrodes were essentially at background. The initial thorium solution showed counts considerably above background. The **after-processing** measurements showed dramatic reduction of radioactivity of the electrolyte **and dra-**

plasma] mass spec analysis. The most notable change in the 12 elements selected for analysis was the dramatic decrease (by over 95%) in the amount of thorium in the electrolyte. Due to the relative high costs of analytical services, a complete elemental analysis has not as yet been accomplished. A commensurate number of newly-produced elements has not, as yet, been determined. Copper and silicon were noticeably increased in the solution. It must be recognized that many of the elements that could have been produced could combine with electrolysis by-products, notably H and O ions, to produce compounds that are not soluble in the aqueous electrolyte. Of course, the change in ion content of the electrolyte is evident by the dramatic increase in the resistance of the electrolyte (Fig. 2 and Fig. 3).

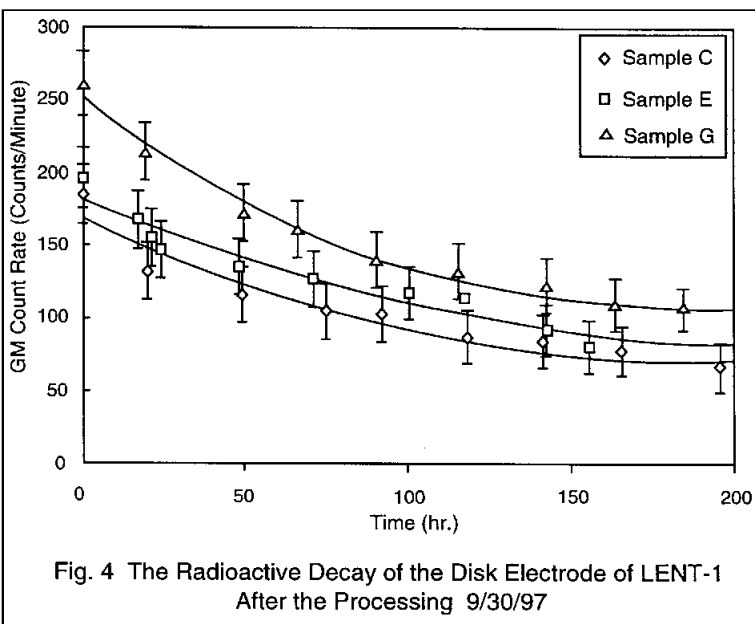


Fig. 4 The Radioactive Decay of the Disk Electrode of LENT-1 After the Processing 9/30/97

matic increase of the radioactivity on the surface of the electrodes.

However, measurements made by placing the disk electrode near the sensor of the Geiger counter showed that the radioactivity of the electrodes is dramatically reduced, apparently on an exponential basis, from about three times background to about one-third above background, over a period of less than 100 hours. See Fig. 4 for typical radiation measurements over a 200-hour period. Note that the combined half-life of the elements that are producing the radioactive emanations ranges from about 50 to 100 hours in different experiments. Some of the disk electrodes were measured using a borrowed alpha detector. A low level of alpha particle emission was noted. The alpha emissions are believed to be a combination of some small amount of thorium and some small amounts of protactinium and its daughter products.

A careful inspection of a Chart of Nuclides will show that any reasonably expected fissioning of a heavy element will result in smaller elements. However, the elements produced can be expected to be among those hundreds of short-lived elements that are "radioactive," usually with short-half lives where the element is transformed into another element by beta-emission.

The **before-processing** and **after-processing** samples of the electrolyte were submitted for ICP [inductively coupled

plasma] mass spec analysis. The most notable change in the 12 elements selected for analysis was the dramatic decrease (by over 95%) in the amount of thorium in the electrolyte. Due to the relative high costs of analytical services, a complete elemental analysis has not as yet been accomplished. A commensurate number of newly-produced elements has not, as yet, been determined. Copper and silicon were noticeably increased in the solution. It must be recognized that many of the elements that could have been produced could combine with electrolysis by-products, notably H and O ions, to produce compounds that are not soluble in the aqueous electrolyte. Of course, the change in ion content of the electrolyte is evident by the dramatic increase in the resistance of the electrolyte (Fig. 2 and Fig. 3).

E. SUMMARY

The LENT-1 is one of an increasing number of devices that exhibit transmutation of elements. These nuclear reactions have been replicated by a few investigators, however, more independent replications and more extensive post-processing analysis will be required to convince skeptics of the reality of this new technology. Working with thorium is an advantage because thorium does not require a "hot lab" environment. Sufficient short-term radioactivity of transmuted products is produced in the LENT-1 which is an advantage to track the nuclear reactions that modify neutrons into protons by beta emission. Typical data indicates that the bulk of the nuclear reactions occur within about a fifteen minute time period of the thirty-minute typical period that transmutes most of the thorium from the electrolyte. Due to the nature of the nuclear reactions, considerable chemical and isotopic analysis will be required by serious experimenters.

ACKNOWLEDGEMENTS

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Gleeson of "the Cincinnati Group" has furnished the LENT-1 reactor. Dr. S-X. Jin has been responsible for obtaining this basic (and preliminary) data.

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