
ELECTROLYSIS OF D₂O WITH A PALLADIUM CATHODE COMPARED WITH ELECTROLYSIS OF H₂O WITH A PLATINUM ELECTRODE: PROCEDURE AND EXPERIMENTAL DETAILS.

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Dear Readers,

We would like to thank you for showing interest in our experiments and also for all the appreciation and encouragement we received during ICCF10. The conference has definitely boosted our morale and we feel much more enthusiastic about the work we are doing at LENL. We are currently trying * to increase excess heat output by exploring different ideas including laser stimulation .

This document contains the experimental procedure that we follow at LENL while conducting our experiments. We have some important details added that we feel would help enhance the excess heat effect. We have also included some typical experimental data and equations to be used for calculating excess heat along with a sample calculation for reference.

Nuclear transmutation seems to be taking place during our experiment. We also present a scanning electron microscope (SEM) image of one of our Pd cathodes along with characteristic x-ray spectra acquired from it. These spectra provide strong evidence of possible “nuclear ash”.

We hope this document will assist you to obtain positive results from your experiment. However, if you experience any problem or have any questions, please feel free to contact us. We will try our best to help you out.

Once again, thank you, and we hope you succeed.

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* Inspired by the demonstration by Dennis Letts and Dennis Cravens during their presentation at ICCF10.

Electrolyte:

Control cell → De-ionized H₂O & H₂SO₄ in the ratio 12.3:1.

Experimental cell → D₂O & H₂SO₄ in the ratio 6.7:1.

Construction of the experimental cell:

1. Electrodes:

- i. Start with a 25mm wide & 0.5mm thick palladium (Pd) foil(Alfa Aesar stock # 11514) and cold roll it into a 0.35mm thick foil. Cut a 25mm x 25mm piece from this foil.
- ii. Punch a hole about 4mm from one of the sides of this foil. A1mm diameter Pd wire about 10cm long (flattened at one end for about 2 cm) is inserted into this hole and bent over the other side to form a U shape. This portion is then spot welded to the Pd foil. This is used as the cathode.
- iii. For the anode, use a 25mm x 25mm x 0.1mm Pt foil and a 10cm long 1 mm diameter Pt lead wire. Perform the same operations as mentioned above in order to make a good contact.
- iv. Place these electrodes in a beaker filled with H₂SO₄ for 5 minutes. Then place them in separate beakers filled with de-ionized water in an ultrasonic cleaner for 5 minutes. This will get rid of any contamination on the electrodes that occurred during their preparation.

2. Catalyst chamber:

- i. The catalyst chamber is a cylindrical Teflon cup, open at the top with numerous perforations on the sides and bottom. Note that a slightly larger hole is needed on the bottom for a Teflon support pole.
 - ii. Fill this chamber with recombination catalyst up to 5mm below full.
 - iii. Carefully insert the cell electrodes into the bottom of this chamber and push them through the catalyst and then through the lid.
3. Add 50ml of the experimental cell solution to the cell beaker and place the catalyst chamber and lid with o-ring on into the beaker. Secure the lid strongly onto the beaker with adhesive tape (see Fig.2). A very good seal is needed to prevent loss of gases.

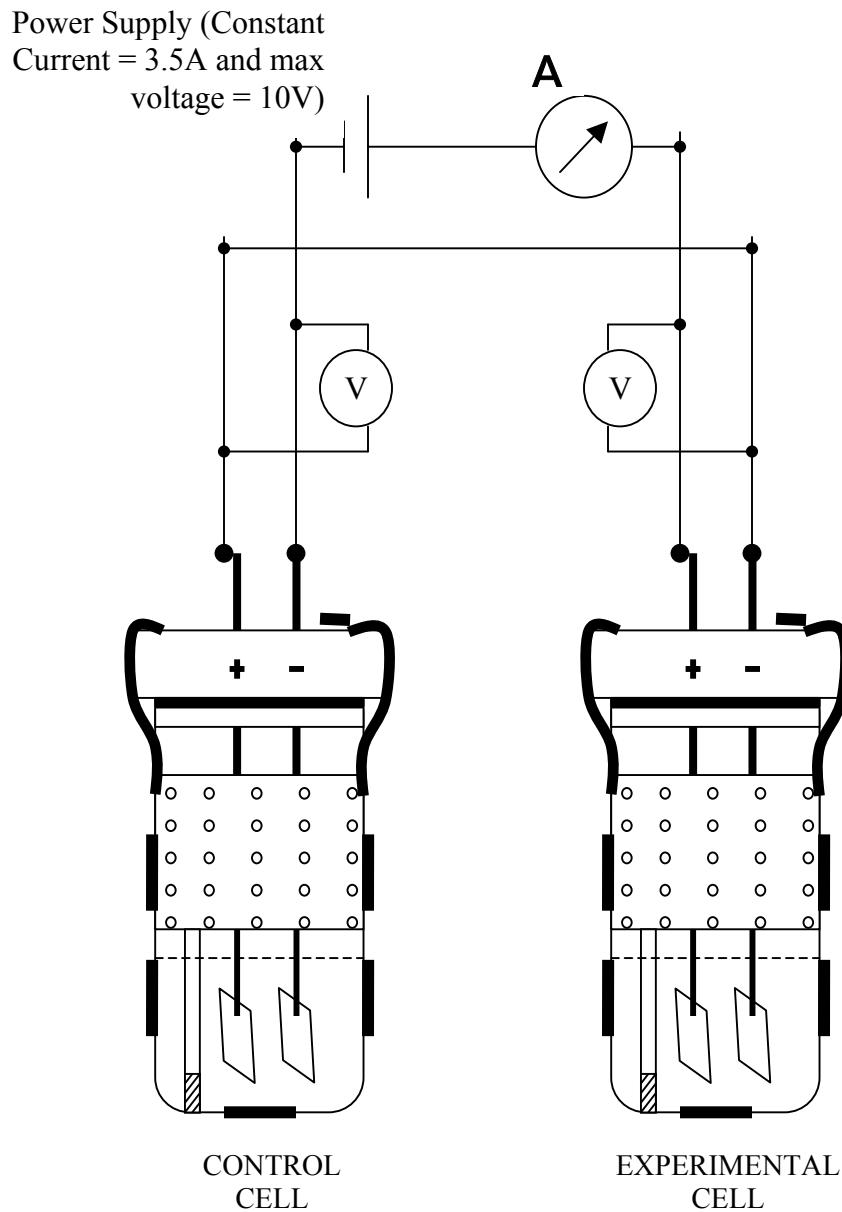
Construction of control cell:

The control cell is prepared similarly to the experimental cell, except that its electrolyte consists of H₂O and H₂SO₄ and its anode and cathode are both Pt foils with dimensions 25mm x 25mm x 0.1mm.

Experimental setup:

- Once the cells are ready, weigh them using a balance with precision $0.1\text{g} \pm 0.05\text{g}$. It is desirable to have an experimental cell with slightly higher mass ($\sim 5\text{g}$) than the control so that its heat capacity is higher. Connect them according to the circuit diagram given in Fig.1 on the next page. Place the plexiglass cover over the cells.

Fig. 1 Circuit Diagram



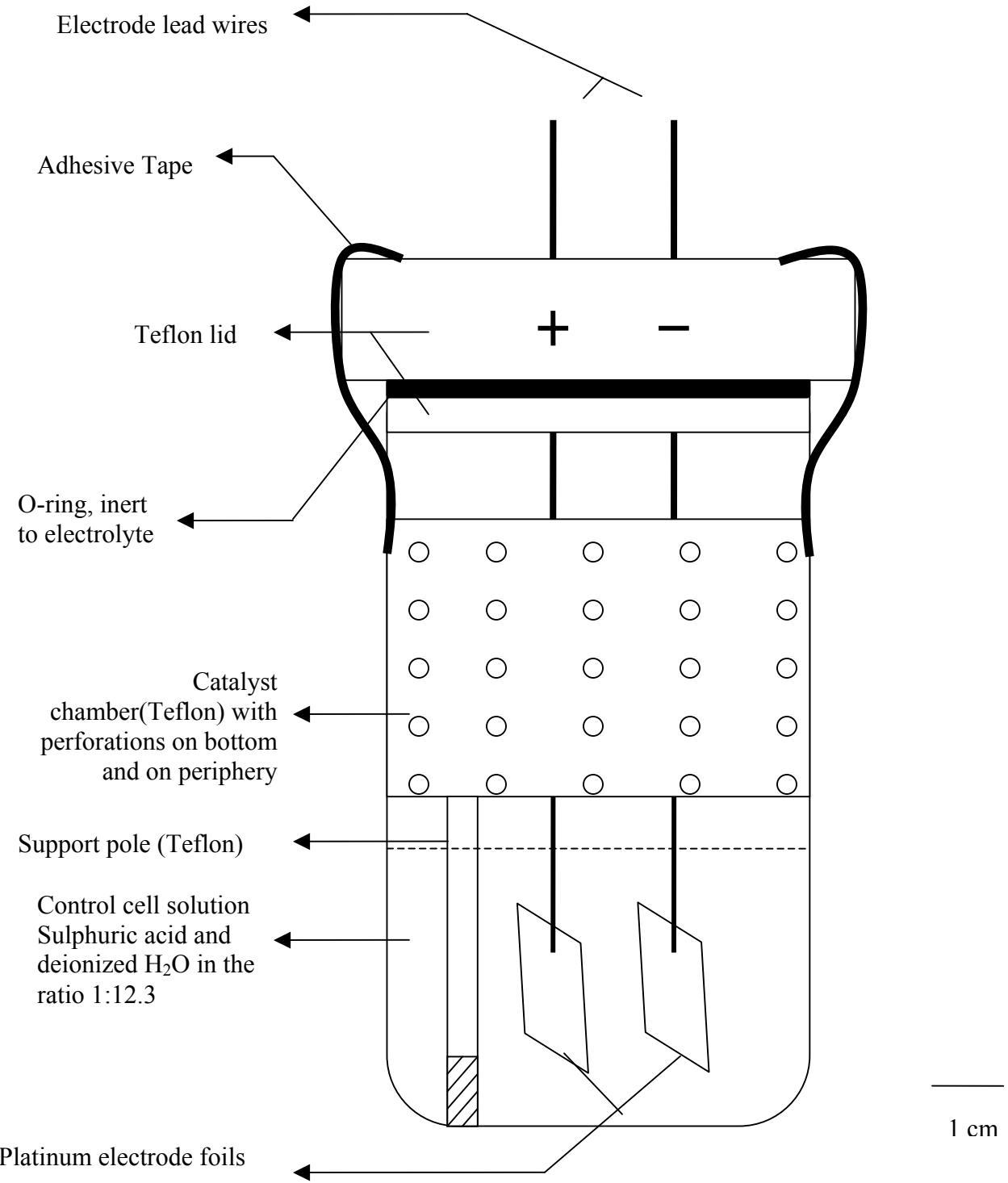
— → Thermocouple(TC). These TCs were connected to a computer, which then provided temperature readout for each cell from the six positions shown above. The cell temperature was then calculated as the arithmetic average of these six readings.

2. At PSU, we used 6 K-type thermocouples (TCs) on each cell. These TCs were then connected to a STP-36CJC board provided by Keithley Instruments that went to EXCELINX program on the computer, which would provide temperature readouts. During our demo at MIT however, we used K-type TCs that went into a Microprocessor Thermometer (Model HH22) manufactured by Omega Engineering Inc. Note: The main difference between the two is that with the former we can acquire and process individual cell temperatures at 6 different positions while the latter is more portable but less versatile.
3. Start the experiment by setting the power supply to output a constant dc current of values up to 3.5A and maximum output voltage of 10V. Note: The bottom of the cell reaches 90 °C on the outside, which means that the electrolyte inside the cell is close to the boiling point. It is not desirable to boil because this would saturate the catalyst with water, rendering it ineffective. Hence the current should not exceed 3.5A.
4. Record the cell voltages and temperatures at regular intervals of 30 minutes. Normally the experiment reaches steady state 2-3 hours after it is started. Run the experiment for about 3 hours after steady state so that a substantial amount of data can be collected.

Something noteworthy:

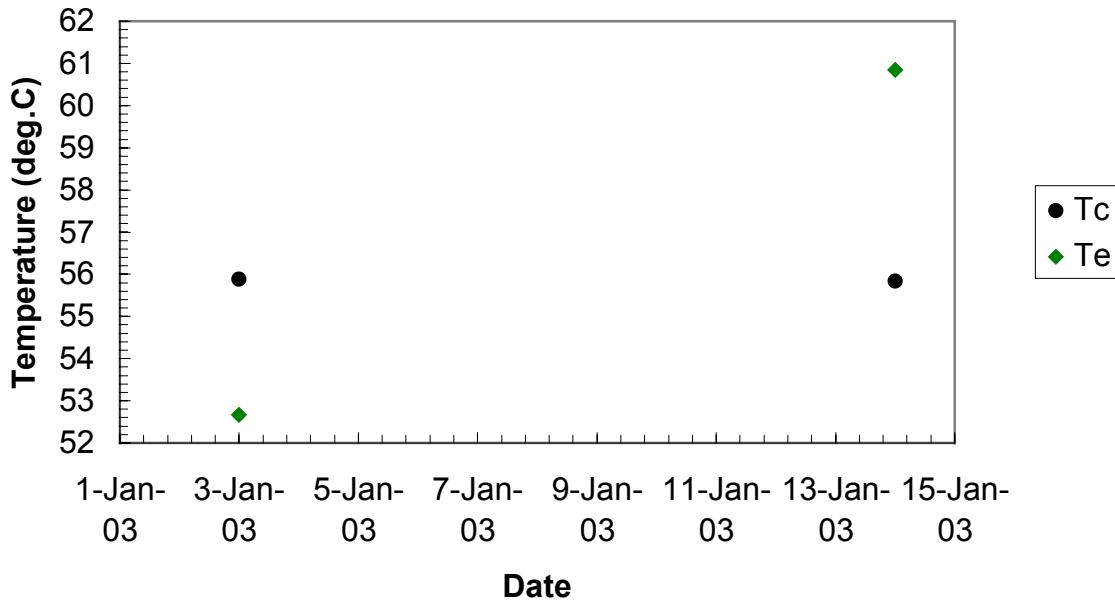
1. Electrode separation and placement inside the cell are factors that effect the production of excess heat. This is because they influence the cell voltages by increasing or decreasing cell resistivity and thereby affect the cell temperature. As far as possible, try to keep the electrodes equally separated from each other (approx. 1cm ± 1mm) in both cells. Their elevation from the cell bottom should also be the same in both cells (approx. 1.2cm ± 1mm).
2. We noticed that excess heat production was enhanced when the direction of current flowing in the circuit was reversed for a limited time period. After about 80 hours of electrolysis, we generally observe a decrease in the excess power output from the experimental cell. We reverse the polarities on both cells for about 30 minutes and then put them back to normal. This causes Pd to deposit on itself. We then obtain a considerable increase in the excess power output. Fig. 3 on page 6 supports this conclusion.
3. The recombination catalyst used in our experiment tends to cease working after coming in contact with water. It causes the pellets (those at the bottom of the chamber) to stick to each other, thus impeding the gases from reaching other ‘dry’ pellets. Although there is not a fixed time period for their lifetime, we suggest you replace the catalyst on a daily basis (approx. 8 hours of electrolysis). Alternatively you could wait for a time when the weight loss from a cell suddenly jumps to an unexpected value. This usually indicates that the catalyst is not functioning properly. Rinsing with water and allowing it to dry completely may rejuvenate the sticky catalyst, but we do not have any proof of this.

Fig. 2 Control Cell



The experimental cell had a Pd cathode. The electrolyte was made of H₂SO₄ and D₂O in the ratio 1:6.7.

Effect of electroplated Pd cathode on cell temperatures



Effect of electroplated Pd cathode on cell voltages

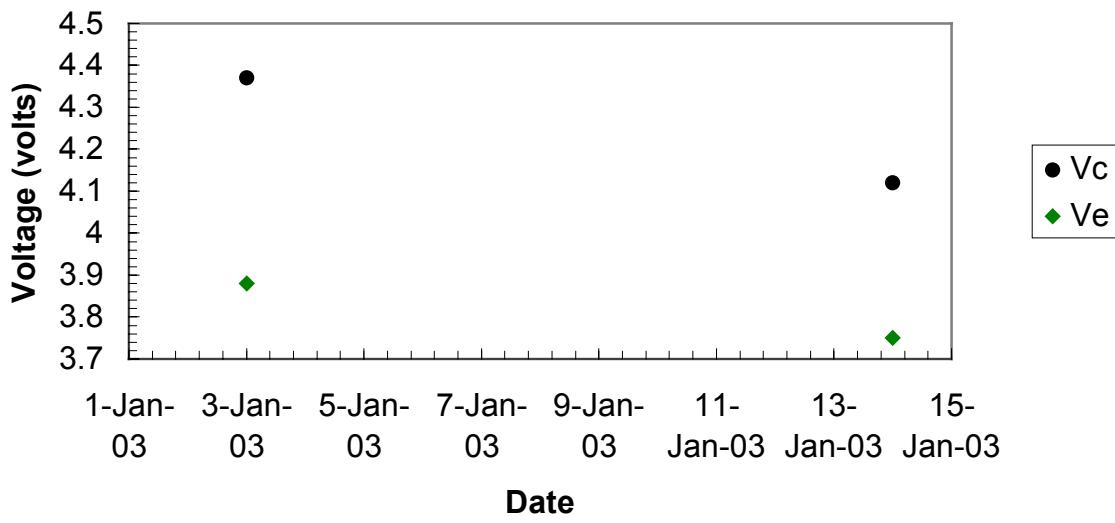


Fig. 3 (above) presents a comparison between the control and experimental cell temperature and voltages observed before and after polarity reversal. On 3rd Jan, we had excess output power from the experimental cell equal to 0.15W as opposed to 3.06W from the same cell on 14th Jan. Please note: V_c refers to the control cell voltage, V_e refers

to the experimental cell voltage, T_c refers to the temperature of control cell and T_e refers to the temperature of the experimental.

We believe that reversing the polarity for 60 minutes on 7th Jan 2003 caused this. When this was done, Pd dissolved in the electrolyte. When the original polarity was restored, Pd deposited on the Pd cathode in the form of a very porous, loosely bound substance.

To end the experiment:

- i. Turn off the power supply and allow the cells to cool for about 30 minutes.
- ii. Take them out from the setup and weigh them to determine the weight loss.
- iii. For calculating excess heat you will need the last (steady state) voltage and temperature data points.

FORMULAE USED & CALCULATIONS:

Control cell evaporation loss (in Watts):

$$dHc/dt \text{ (evaporation)} = \{\text{Control cell weight loss(in grams)}/ \text{Molecular weight of H}_2\text{O(in grams)}\} * \{4.18 * \text{Heat of formation of H}_2\text{O(in calories)}/ \text{Duration of experiment (in seconds)}\}.$$

Experimental cell evaporation loss(in Watts):

$$dHe/dt \text{ (evaporation)} = \{\text{Experimental cell weight loss(in grams) / Molecular weight of D}_2\text{O(in grams)}\} * \{4.18 * \text{Heat of formation of D}_2\text{O(in calories)}/ \text{Duration of experiment (in seconds)}\}.$$

(where 4.18 is a constant to convert calories to joules)

Excess power output from experimental cell(in Watts):

$$dHe/dt \text{ (excess)} = \{(T_e - T_a) / (T_c - T_a)\} * \{(V_c * I) - dHc/dt\} + dHe/dt - (V_e * I)$$

where,

T_e → Experimental cell temperature in °C.

T_c → Control cell temperature in °C.

T_a → Ambient temperature in °C.

V_c → Control cell voltage in volts.

V_e → Experimental cell voltage in volts.

I → Current flowing in circuit in amperes.

Sample calculations:

Date: 9th May 2003 (steady state values)

$$V_c = 3.34 \text{ V}$$

$$T_c = 63.9 \text{ } ^\circ\text{C.}$$

$$V_e = 3.20 \text{ V}$$

$$T_e = 65.2 \text{ } ^\circ\text{C.}$$

$$I = 3.0 \text{ A}$$

$$T_a = 24.4 \text{ } ^\circ\text{C.}$$

Weight lost by control cell = 1.6g.

Weight lost by experimental cell = 2.1g.

Duration of experiment = 525 minutes = 31500 seconds.

$$dH_c/dt(\text{evaporation}) = (1.6 / 18) * (4.18 * 57.79 * 10^3 / 31500) = 0.68 \text{ W.}$$

$$dH_e/dt(\text{evaporation}) = (2.1 / 20) * (4.18 * 59.56 * 10^3 / 31500) = 0.83 \text{ W.}$$

$$\begin{aligned} dH_e/dt(\text{excess}) &= \{(65.18 - 24.4) / (63.93 - 24.4)\} * \{(3.34 * 3) - 0.68\} + 0.83 - (3.2 * 3) \\ &= \mathbf{0.87 \text{ W}} \end{aligned}$$

On the next page we have two graphs that show data points collected on 9th May 2003 as reference. Please note: The plexiglass cover was not used to cover the cells in this experiment.

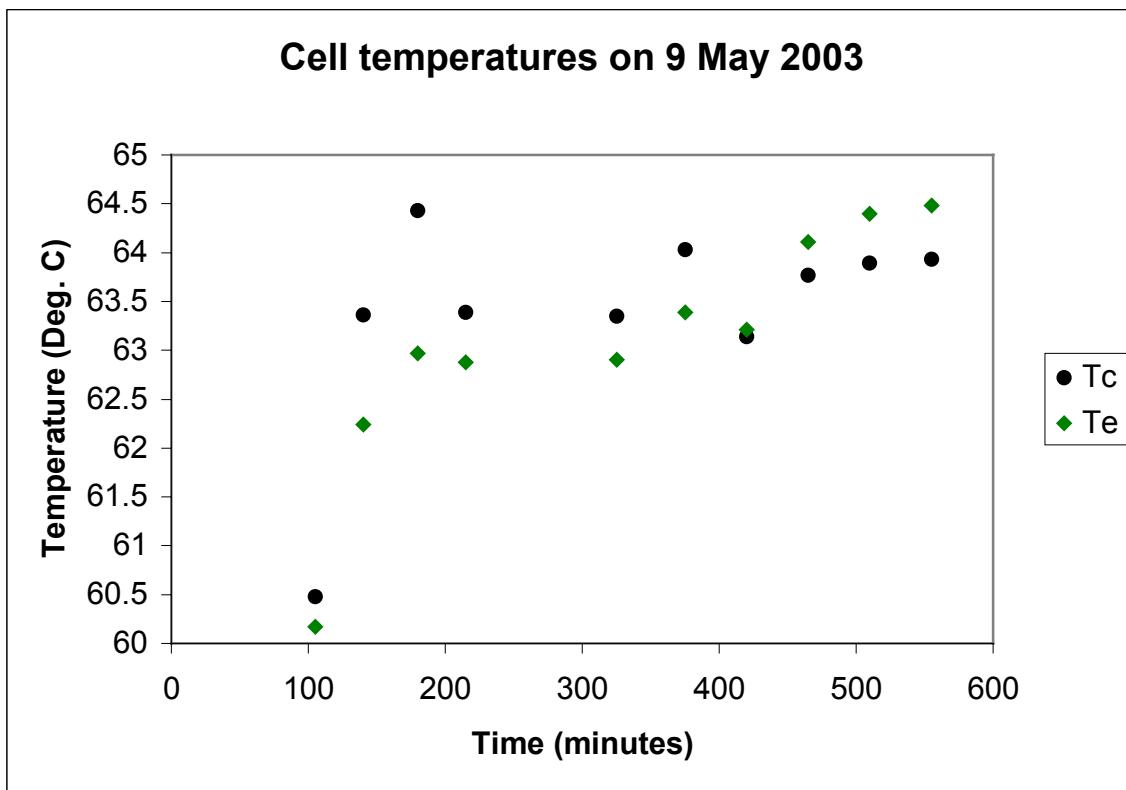
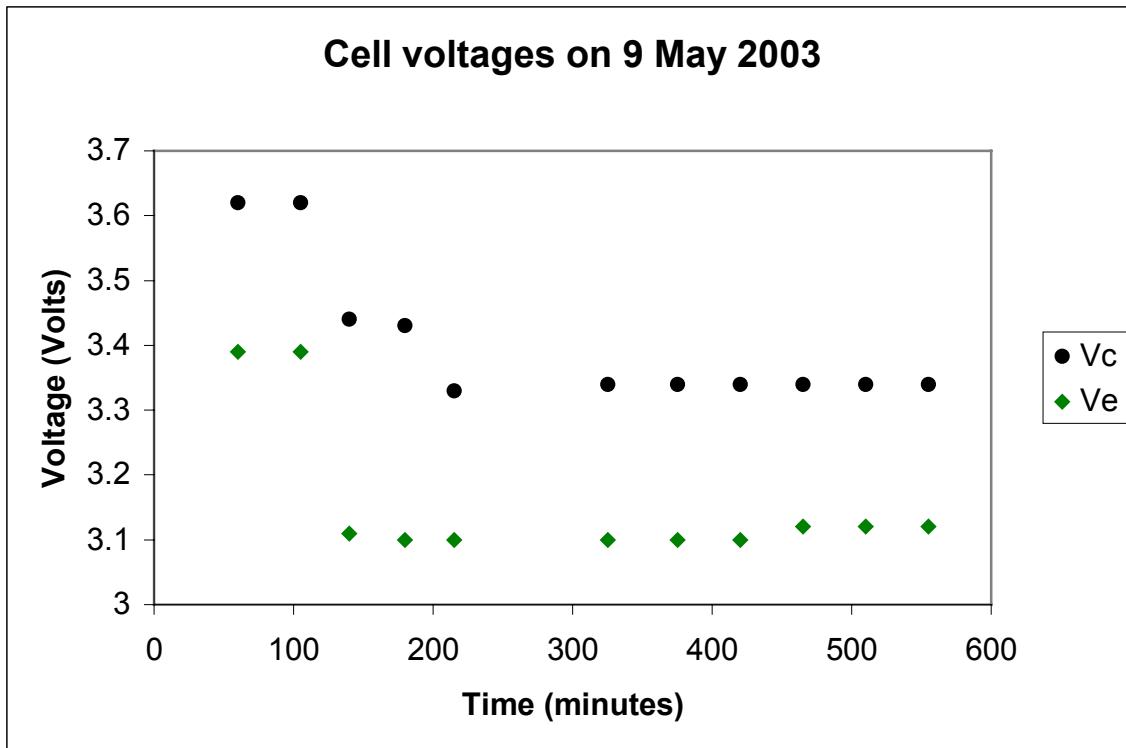


Fig. 4 A typical day in our lab.

Evidence of possible transmutation:

We perform x-ray analysis using a energy dispersive spectrometer(EDS) and a scanning electron microscope(SEM) on the Pd cathode from the experimental cell before and after the experiment. Initially, the cathode surface would consist of Pd and some carbon(C) and oxygen(O). However after the experiment we found up to 20% silver using spot analysis. This examination suggests a strong possibility of nuclear transmutation. We believe that a Pd atom absorbs a neutron , goes into an unstable state, which then stabilizes by emitting an electron and gives rise to a stable silver atom.

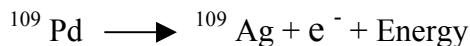


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10μm

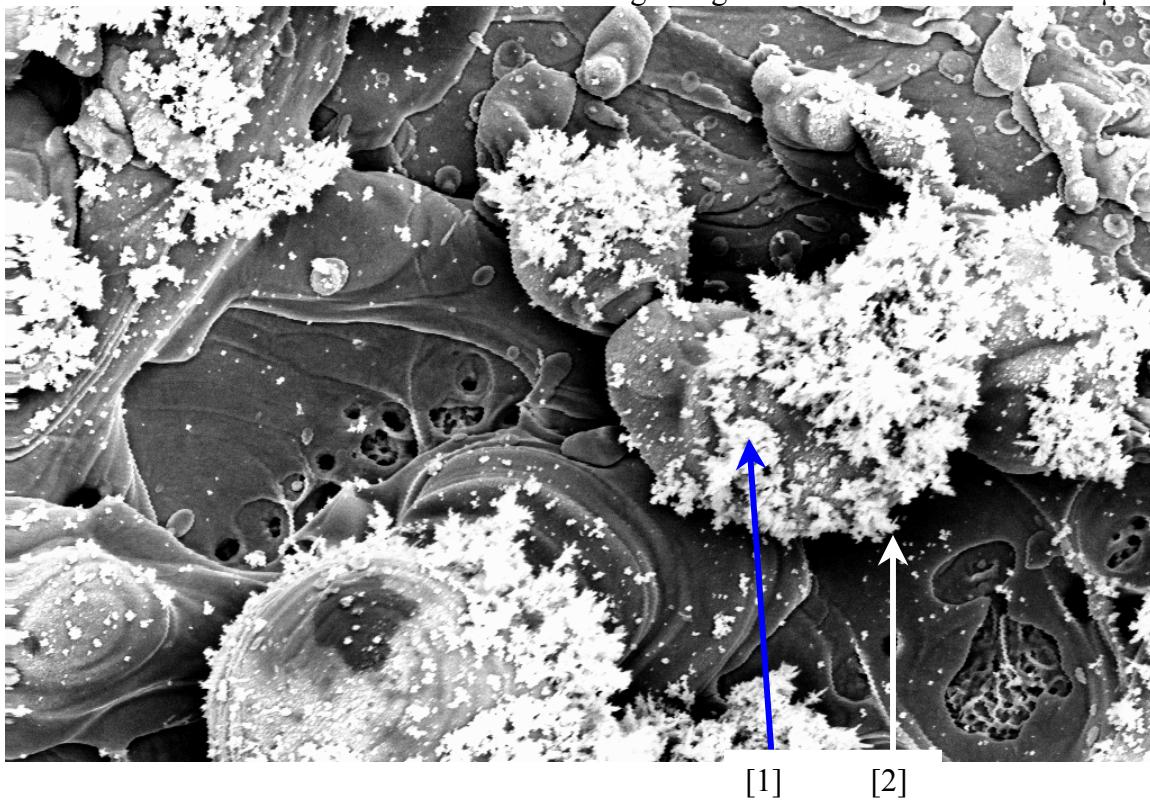


Fig. 5 (above) shows an enlarged SEM image of a small area on the Pd cathode from one of our experiments. Besides the interesting topography, we found some stimulating results during x-ray analysis of spots 1 and 2 (see Fig. 6. on the next page). From spot #1 (looks like a bright spot) we did not find any elemental silver. However, on spot# 2, we had as much as 19% elemental silver (values obtained by performing quantitative analysis using EDS). Spectrum[1] shows that the Pd L β /L α ratio is about 0.4 and notice that its value is 0.75 in [2]. The former suggests presence of Pd only, while the latter indicates silver x-ray energy lines superimposed with the Pd lines.

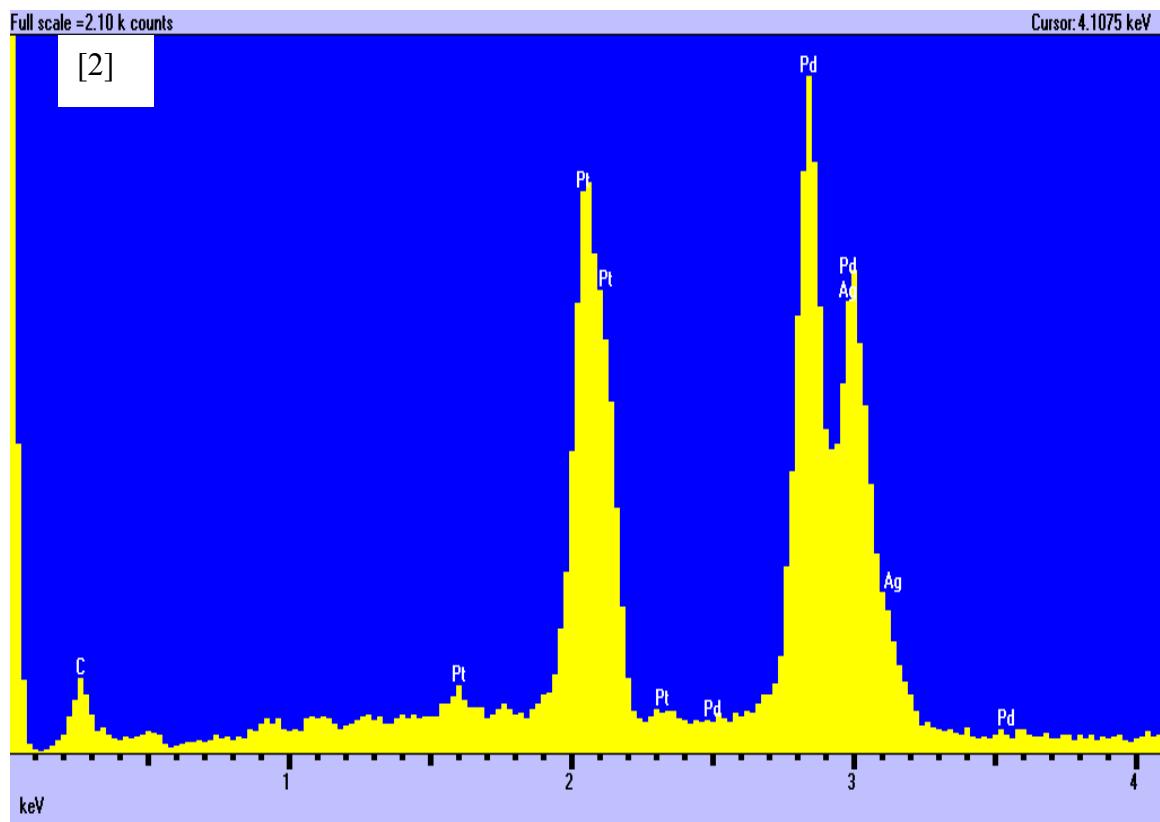
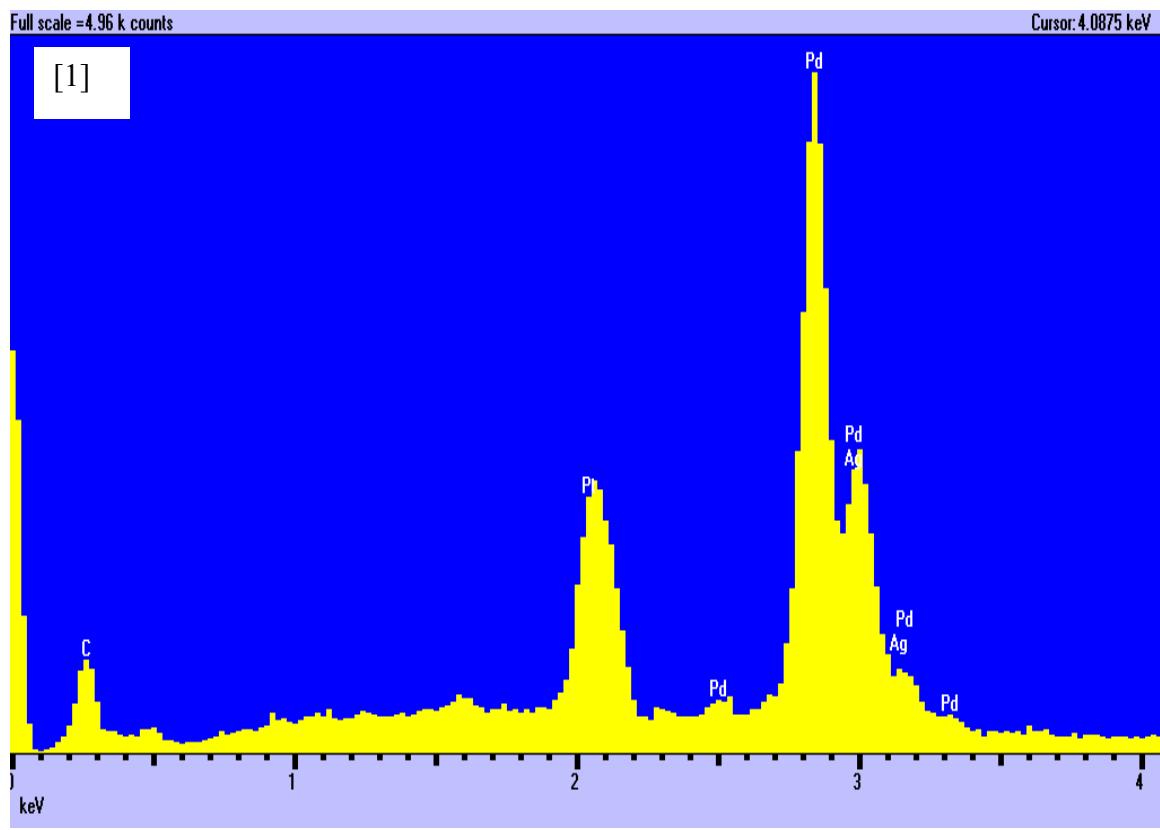


Fig. 6.

APPENDIX

List of reagents, apparatus and instruments required for the experiment:

Reagents:

1. Heavy water – 100ml, 99.9% pure, lot # 00318CU by Aldrich Chemical Company, Inc.
2. Sulphuric acid – 20ml, 99.999% pure, batch # 11309EB by Aldrich Chemical Company, Inc.
3. Deionized water – 100ml.
4. Recombination catalyst – 200g, Pt 0.5% on 1/8 inch. Alumina pellets, lot # J14M16 by Alfa Aesar.

Apparatus:

1. Glass beakers (2), capacity: 200 ml (flared on top, but without any spout). Spare beakers would be on hand in case of breakage.
2. Teflon lids(2) (for the beakers) with two holes, 1 mm diameter in each for the electrode lead wires. O-rings made of ethylene propylene(resistant to sulphuric acid) are used to seal the lids against the flared ends of the beakers.
3. Teflon catalyst chambers(2) with perforations on the bottoms and around the circumference to hold the recombination catalyst. These were made from 100ml Teflon beakers. A Teflon rod fastened to the bottom of each beaker served to suspend the chambers above the electrolyte.
4. Platinum lead wire – 1.0mm diameter, about 15 inches long(4.5 inches for each electrode except the Pd electrode which requires about 4.5 inches Pd wire, 1mm diameter).
5. Platinum electrode foils(3), two with dimensions 25mm x 12.5mm x 0.1mm for the control cell and one with dimensions 25mm x 25mm x 0.1mm for the experimental cell.
6. Palladium electrode foil with dimensions 25mm x 25mm x 0.35mm for the experimental cell. Please note that we started off with a 0.5mm thick foil and cold rolled it to 0.35mm. We recommend that you purchase Alfa Aesar(a Johnson Matthey Company) lot # 11514.
7. Type K thermocouples(10), 5 per cell. We use Omega self-adhesive thermocouples, which we seal against the outside of each cell.
8. Vinyl tape for sealing the cell lids against the flared tops.
9. A two-gallon fish tank with about 5mm thick plexiglass walls and two openings. The tank is placed up side down over the cells for protection in case there is an explosion(highly unlikely if the experiment is performed correctly). One of the openings houses a probe to monitor ambient temperature inside the fish tank. A tube is fastened onto the other opening to conduct any escaping off-gases to a container of recombination catalyst.
10. A styrofoam base to insulate the cell bottoms.

Instruments:

1. Multimeters(2)
2. Ammeter(1)
3. Power supply(1), should be able to provide a constant dc current of 3.5A and a minimum output dc voltage of 15V.
4. Digital thermometer(s) that provide(s) temperature output from thermocouple input. Alternatively, a PC with data acquisition software can be used to monitor all of the thermocouples.
5. Connecting wires and crocodile clips, required as per circuit diagram shown on page 3.