

AEH and the Blue Glow

Horace Heffner Feb. 2002

(An edited composite of postings on vortex-1)

In 1996 I proposed The Atomic Expansion Hypothesis (AEH), the idea that atomic expansion (AE), the increase in the size of an ionized atom or molecule, like H^+ , which occurs when it takes on an orbital electron, can perform work on the surroundings of the ion, and that the amount of energy released can be greater than the initial ionization energy, provided the ion is in a sufficiently confined space when the expansion occurs. For convenience, the AEH has been reposted separately. It is the purpose here to relate the AEH to excess energy noted in association with the blue glow observed in high voltage electrolysis experiments.

I have recently reported here on vortex seeing a blue glow in high voltage electrolysis cells, and that this glow is in the proximity of the anode. This glow may be due to recombination. H^+ ions are made at the anode, which removes electrons in its vicinity, and releases O_2 . These ions attach to H_2O molecules, forming an H_3O^+ radical. It is said (e.g. by Bockris) that conduction in water electrolytes is almost entirely by proton conduction, i.e. by H_3O^+ molecule rotation, and by proton tunneling from H_3O^+ molecules to adjacent H_2O molecules, or via H_3O^+ chains to an H_2O molecule. OH^- radicals also migrate (but) by diffusion. This mechanism indicates a slow OH^- migration, and a very fast proton migration.

I have posted various experimental results here on vortex, which show long square pulse wave fronts move through water at above 0.1 c. The full current is established very fast, and the inertial mass of the proton, or rather the 1700 to 1 ratio of mass of the proton to the electron, precludes the current being established so quickly. I concluded that there must be at least some electron conduction occurring in the electrolyte. My feeling was that ion-molecule chains, i.e. OH^- chains, or OH^- to H_2O to OH^- ... chains, may provide a tunneling path for electron conduction. The very long tunneling distance of electrons make their (fast) migration far more likely over molecular distances than proton tunneling.

If the blue glow nearby the anode is indeed recombination, then that indicates that the migration of negative charge through the electrolyte occurs faster than the migration of positive charge via proton conduction. Otherwise, at the onset of conduction, protons would zip to the cathode face, and there meet the OH^- ions which are merely moving by diffusion once more than a few molecular distances from the electrode. The field gradients near the cathode and anode have been measured, and the potential drop across a cell is almost entirely in close proximity to the electrodes. Ion migration though the cell has therefore been theorized to be almost entirely by simple diffusion (see Bockris.)

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Also of note is that heat evolution has been noted to be more in the vicinity of the anode, rather than the cathode. Recombination in the vicinity of the anode would help explain that. Recombination would also explain why the blue glow was observed to be positively related to current density. Increased current means increased proton mass flow, thus an increased recombination rate.

In the AEH, I suggested that protons (if there is a sufficient voltage drop) might be injected into the electrolyte at the anode. In that case, the electrolyte itself would be acting as a "target" cathode, and the kinetic energy gained by the proton while passing through the anode potential drop, especially if doing so in a plasma regime, would inject the nearly zero volume particle relatively deep into the electrolyte. Upon encountering an electron, the hydrogen would then be expanded into an orbital by energy supplied from the vacuum, thus "free" energy supplied to the electrolyte. Alternatively, the hydrogen could encounter an OH⁻ radical, and recombine to form water, or simply join an H₂O molecule to form an H₃O⁺ radical, which can then go on to eventually result in recombination, or direct release of hydrogen via electonation at the cathode. In any case, the formation of an orbital around some of the injected protons should result in free energy from the ZPE sea via atomic expansion.

An earlier posting follows.

Suppose atomic expansion (see AEH) is providing the energy in Mizuno type high voltage electrolysis, by blasting protons into the cathode through the gas sheath, and then gaining excess energy from the proton expansion upon proton collision with the cathode. If that is the case, then perhaps the cell is designed all wrong! The cathode should be a large area electrode and the anode should be small in area. The place to have the plasma sheath, or at least blue glow effect, is around the anode! In that way the atomic expansion will occur in the water, not on the electrode surface!

Protons will be stripped from the H₃O⁺ radicals close to the anode and blasted through the water until hitting OH⁻ radicals attracted to the anode. An atomic expansion then takes place when the recombination takes place. Spontaneous ionization converts some of the water back into OH⁻ and H₃O⁺ radicals and that completes the cycle. Similarly, in a sufficiently high gradient, electrons may be stripped off of OH⁻ radicals leaving OH molecules. The

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electrons so removed then, in the high electrostatic field, blast through the water until hitting H3O+ radicals and then freeing the hydrogen, causing atomic expansion. This would cause hydrogen to evolve in the vicinity of the anode! Such a thing might cause the Faradaic efficiency to be exceeded! (as Mizuno observed.) In addition, hydrogen peroxide would tend form in the vicinity of the anode.

I have done a number of experiments where a blue glow was created at the anode, as distinct from either an electrospark effect or and arc or plasma sheath effect.

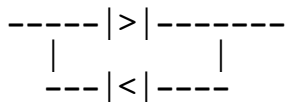
Experiment Report 11/7/97

Added water to electrolyte to compensate for evaporation.

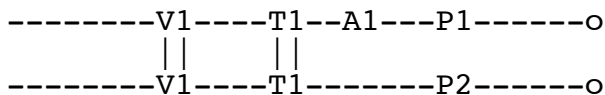
"Warmed up" cell by running at about 100 mA (variac at 10 then up to to 20 %) for about 5 minutes. Glow clearly visible in dark but noise not yet started.

Put some dummy diode pairs (P1 and P2) rated at 15kV Peak V, 100 mA, into circuit like so:

P1 and P2 both look like:



Circuit:



V1 - variac
T1 - HV transformer
A1 - mA meter
Pi - dummy diode pairs

Continued to run as before about 5 minutes. Both electrode glowed as before. This verifies that 2 pairs of these particular type

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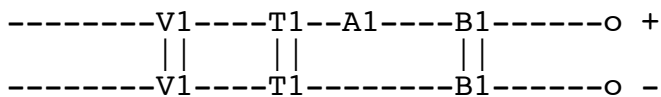
of diodes work OK in circuit.

Tried geiger counter within about 1" of electrodes. Got no increased counts.

Switched off variac when current was at 70 mA, leaving voltage setting alone.

Then inserted full bridge B1 made of same type of diodes:

Circuit:



V1 - variac
T1 - HV transformer
A1 - mA meter
B1 - full rectifier bridge

Switched on variac and noted:

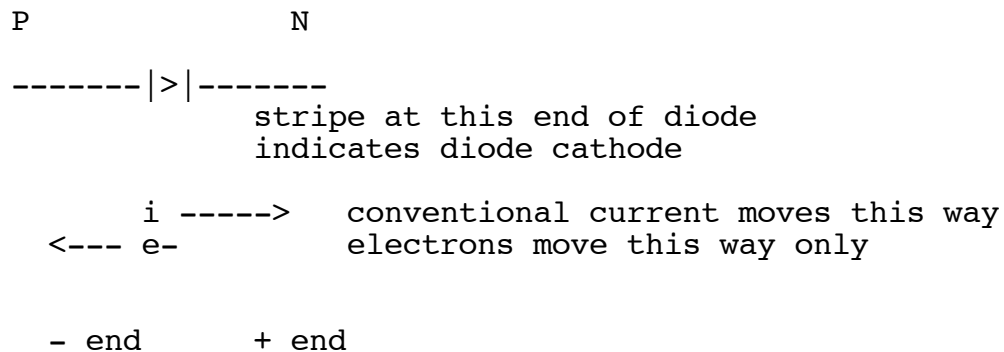
- (1) only one electrode lit, the other was totally dark
- (2) it was not nearly as bright as before
- (3) noticeably more gas evolved at the dark electrode when DC used
- (4) same current (about 70 mA).
- (5) unexpectedly, it was the anode that lit.
- (6) the full surface of the anode lit, as before

Swapped + and - leads and the other electrode lit. Glow went with the + pole.

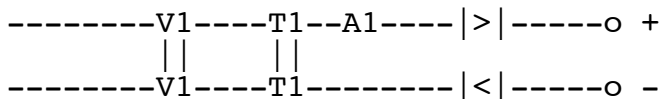
Just to check my understanding, the diodes are marked with a stripe at the end:

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If circuit is like below then electrode marked + is anode of cell:



It is the anode of the cell, the electrode closest to the bar on the diode that glows.

This indicates that the glow is oxygen related and not hydrogen related. It likely is oxidation reaction of Al. That is a very bright reaction, so that makes some sense.

The reduced brightness indicates that maybe hydrogen plays a role in adding heat to the reaction? Or maybe the H2 is necessary to produce full bubble collapse along with massive heat of recombination focused in sonoluminescent bubbles?

Could it be that some other electrode metals glow also, but in invisible parts of spectrum. If so, they should still produce the noise, the cavitation, provided the oxide is an insulator.

Experiment report 11/12/97

To check the hypothesis that the blue glow is from phosphorus in detergent, the cell was emptied, leaving the old electrodes and wetted sides in order to transfer some small amount of NaOH

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solution and to have the benefit of conditioned electrodes. Then distilled water was added. The voltage was turned up over the 50% mark (about 900 V) and no glow was seen. The cell was allowed to run for about 15 minutes, but no light was visible. This part of the experiment should be done again using a longer time frame and more careful checking for the glow, maybe using a video.

Then some "Electrosol with BAKING SODA Automatic Dishwasher Detergent" was added. The detergent is rated as no more than 6.1 percent phosphorus. However, it contained white granules and blue granules. I added one blue granule and 4 white granules to the cell. Set voltage so as to get about 10 mA, which was at 50 percent (about 900 V). Gradually over about 5 minute period, as granules dissolved, current rose to about 20 mA. I then turned out the lights and thought maybe I could see a blue green glow. (As usual, I was cowering about 8 feet away, operating by remote control extension cord.) I turned the voltage up to 100 % and current to about 40 mA and the electrode could clearly be seen to have a fairly uniform non-sparking blue-green glow. I got up close and could see a few stable unmoving non-blinking spots.

I then put the voltmeter on the cell. I measured the following voltages and variac percents:

Var. %	Volts
10	190
20	363
30	540
40	710
50	873

I stopped there because my meter is only rated at 750 V.

I then tried to discern the glow onset voltage by quickly wiggling the knob at the visibility threshold level. That level was 30-32 percent, roughly 540-576 V. Above that brightness seemed proportional to added voltage.

After running at 50 percent for about a half hour water was warm to the touch, over 90 F, which was a surprise. It shouldn't have been a surprise. At 550 cc that would represent about 6105 J for the estimated 11.1 C. For 30 Min. that's about 3.4 W. I was running at 874 V at 19.5 mA, so that's 17 W. No surprise there, but it will be interesting to do a better job of measuring the heat output. There were no visible bubbles. I looked at the

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spots again at 50 percent and 100 percent. At 50 percent the spots could be seen to be twinkling a bit, much more at 100 percent. The spots seemed somewhat orange. There were some dark patches on the electrode surface that might have been from dirt or varnish.

This was just a rough experiment to try to rule out detergent, but was unsuccessful in that objective. It was very successful in obtaining a consistent blue glow, higher operating voltages, and no sparks.



CaO Experiment #3 - 12/2-3/1997

In an attempt to eliminate calcium contamination as a source of the blue glow in prior experiments (#1 and #2) with miscellaneous electrolytes in cells with AL electrodes run at medium to high voltages (100 V - 2000 V), an attempt was made to prepare 0.2 g/l CaO solution by putting 0.09 g of CaO into 450 ml deionized water, and letting it stand overnight. Not all the CaO dissolved, so it is assumed the electrolyte was saturated.

The source of the CaO is Ball 100% Natural Pickling Lime (Hydrated lime, 35% Ca) distributed by Alltrista Corp., P.O. Box 2729, Muncie, IN 47307-0729. Price was \$1.17 per lb. at Wal-Mart.

The electrolyte was then used in two experiments, one with foil electrodes (#1) and one with wire electrodes (#2), so it is

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anticipated that the electrolyte contains Al ions. In addition it is known the electrolyte was contaminated with Na₂SiO₃ from the electrodes used in the prior experiment (#2). The experiments #1 and #2 appeared to have episodes of over unity energy production, so this experiment was done to confirm that the electrolyte was still capable of the effect using new foil electrodes. Of the 450 ml it is estimated that 44 ml was discarded or lost to evaporation. For this experiment 44 ml deionized water was added to the electrolyte and then 421 ml of the electrolyte was used in the cell. It would be advantageous in the future to measure pH before and after a run.

A new 16 oz Ball Mason Jar and new foil electrodes were used to make the cell, in order to avoid contamination. The electrodes were made from Reynolds Wrap.

For protection from high voltage and from the electrolyte, the thermistor probe was inserted into a 26 cm long 8 mm OD closed end glass tube laying on a diagonal in the cell, and the probe positioned to be 2/3 of the depth away from the bottom of the cell, 1/3 away from the electrolyte surface. The same glass probe cover was used in the prior experiment, but was cleaned with a damp Kleenex.

In the initial experiment (#1) with this specific electrolyte, an x-y plot of current as a function of voltage quickly produced an "eye" shape, indicating the electrodes were coated with an insulating film which produced a capacitance, and thus a phase difference between current and voltage, with current leading voltage. The experiment presently described (#3) did not produce such a phase angle for some reason. Both foil electrode experiments with this electrolyte (#1 and #3), when viewed in the dark about 2 minutes into the experiments, produced a blue-green glow about the electrodes. The electrodes were not identical in size, and the smaller electrode of the pair produced the brightest glow in both experiments. Experiment #2 was enclosed in a dewar and thus the glow, if present, was not observed.

A corrosion effect on the electrodes appears to occur at a rate proportional to current density. The glow brightness also appears proportional to current density. There were no sparks observed in this or the prior CaO experiments, only glow.

Note that the experiments with CaO thus far have incorporated a powerful magnet near the electrodes. The magnet is comprised of four 35 MgO magnets placed together to make a 1"x1"x2" magnet. The top of the magnet, a pole, is placed about 1" below one foil

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electrode and just outside the cell. The longer electrode was nearest the magnet in all cases. The shorter electrode always experienced much more corrosion with CaO electrolytes, as would be expected from the higher current density. The short electrode in all cases has been eaten through in at least a 0.3 cm dia hole located in the center of the portion of the electrode in the electrolyte. This seems unusual, as one would expect the greatest field gradients and currents at the edges of the foil.

The temperature was allowed to decay at the end of the experiment in order to get some calorimetric parameters on the configuration. Note also how temperature dropped rapidly when input power was dropped to about 10 W at about 160 V rms. The "P out" drop at the 25, 28 and 30 minute marks may be due to foil disintegration, but also due to heat loss from the hot jar due to convection, evaporation, and IR radiation. The time numbers are time of day, excluding hour. Time 18 is the zero moment. At times 29 - 89, the changing values of $W/(\text{deg. C})$ with temperature for the cell is interpreted to mean more mechanisms affect heat loss at higher temperatures, e.g. evaporation and IR radiation are more significant.

Gas production appeared to be very good but needs to be measured - it may have been mostly steam, and appeared to be more than expected for the current involved.

Note that "P in" is calculated here as the average of the prior $V \cdot I$ and current $V \cdot I$.

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Data follows:

Time	V rms	I rms	Temp.	P in	P out	Tare	Ambient	Volume	Delta t
	24.30	421	0						
19	351	0.1410	43.77	47.82	58.37		24.30	421	1
20	348	0.1510	45.93	51.02	63.35		24.30	421	1
21	349	0.1590	48.02	54.02	61.30		24.30	421	1
23	339	0.1720	52.23	56.90	61.74		24.30	421	2
25	336	0.1810	55.96	59.56	54.70		24.30	421	2
27	333	0.1930	59.49	62.54	51.77		24.30	421	2
28	334	0.1910	61.07	64.03	46.34		24.30	421	1
30	161	0.0792	62.89	38.27	26.69		24.30	421	2
31	163	0.0741	62.15	12.41	-21.70		24.30	421	1
35	168	0.0618	58.70	11.23	-25.30		24.30	421	4
36	168	0.0596	57.91	10.20	-23.17		24.30	421	1
37	169	0.0571	57.22	9.83	-20.24		24.30	421	1
39			55.34		-27.57		24.30	421	2
41			53.22		-31.09		24.30	421	2
42			52.19		-30.21		24.30	421	1
49			46.33		-24.55		24.30	421	7
68			37.26		-14.00		24.30	421	19
89			32.60		-6.51		24.30	421	21

The following is an attempt to compensate for heat lost from the 16 oz Ball Mason jar and to calculate total energy produced by foil consumption. Note that a conservative (conservative given the temperature range in which the cell was operating) value of 0.8 W/(deg. F) was used to calculate the Tare value, which is then added to P out to get the corrected "Cor P out".

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P in	P out	Tare	t	Cor P out	COP	E in joules	E out joules
0.00	0.00	0.00	0	0	0.00	0	0
47.82	58.37	34.22	1	92.59	1.94	2869	5555
51.02	63.35	35.88	1	99.23	1.94	5930	11509
54.02	61.30	37.58	1	98.88	1.83	9172	17442
56.90	61.74	40.10	2	101.84	1.79	16000	29663
59.56	54.70	43.28	2	97.98	1.64	23147	41420
62.54	51.77	46.18	2	97.95	1.57	30652	53173
64.03	46.34	48.22	1	94.56	1.48	34494	58847
38.27	26.69	49.58	2	76.27	1.99	39087	68000
12.41	-21.70	50.02	1	28.31	2.28	39832	69699
11.23	-25.30	48.34	4	23.04	2.05	42527	75229
10.20	-23.17	46.64	1	23.47	2.30	43139	76637
9.83	-20.24	46.05	1	25.81	2.63	43729	78186

W/(deg. F)

-27.57	2	-0.86
-31.09	2	-1.04
-30.21	1	-1.06
-24.55	7	-0.98
-14.00	19	-0.80
-6.51	21	-0.61

The total excess energy was $78186 \text{ J} - 43729 \text{ J} = 34457 \text{ J}$.

The electrodes were measure at $2.2 \text{ cm} \times 0.8 \text{ cm}$, and $3.5 \text{ cm} \times 0.8 \text{ cm}$, for a total area of 4.4 cm^2 or $(4.10 \times 10^{-2} \text{ g/cm}^2)(4.4 \text{ cm}^2) = 0.18 \text{ g}$ of Al, of which only at most 0.09 g was consumed, mostly from the smaller electrode , which was furthest from the magnet. This gives $(0.09 \text{ g})(14,800 \text{ cal/g}) = 1332 \text{ cal} = 5567 \text{ J}$ from Al oxidation max.

Therefore the excess heat is estimated at $34457 - 5567 = 28890 \text{ J}$. This gives a total COP = $78186 / (43729 + 5567) = 1.59$.

This is dramatic, but the calorimetry was far from ideal. An attempt to use Al wire electrodes with a similar surface area, but enclosed in a dewar flask to improve calorimetry, produced far less exciting results. The electrolyte is roughly the same, so several possible explanations come to mind:

(1) As the calorimetry improves the effect vanishes (not a new

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phenomenon)

(2) The wire electrodes may be a different composition from the Reynolds Wrap foil.

(3) The fact the wire electrodes were scraped with sandpaper to remove a coating and increase conductivity may have significantly increased their surface area and thus reduced current density, thus eliminating the effect.

(4) The prior use of the wire electrodes with a 0.1 g/l Na_2SiO_3 electrolyte may have corrupted them.

One possibility for further investigation is the use of a new pair of wire electrodes with the same Mason Jar cell and the same electrolyte to determine if the wire is not effective. Also of importance is stirring the electrolyte to avoid delays in registering thermal changes. The efficacy of pulsed DC should be checked early on, because if it works then cells can be made much safer by venting pure O_2 and H_2 instead of the potentially explosive mixture. Cells seem to work better at higher temperatures, so the boiling regime should be studied, and may provide improved calorimetry. At minimum, the electrolyte should be preheated to about 50 C.

Also of future interest is the amount of steam generated, and evaporation. There was a clear drop in electrolyte volume. As the heat of vaporization of water is 540 cal/g, that's $(4.18 \text{ J/cal})(540 \text{ cal/g}) = 2257 \text{ J/g}$ of water. In adjusting the concentration of the electrolyte prior to this run, by adding water, it was very roughly estimated that a minimum of 5 ml was lost to boiloff (the cell was enclosed) in Exp. #2, or about 11,300 J, which is a significant contribution to the output energy. The total estimated input vs output joules was 87188 vs 84800, which is changed by the boiloff to 87188 in vs 96100 out.

One problem with not using foil electrodes is the fact that it is not possible to determine aluminum consumption. This is due to the crusting that develops, thus preventing weighing the electrodes. Possibly very long runs can resolve this issue.

At 6:16 PM 4/26/98, Jed Rothwell wrote:

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Y. Iwamura, Mitsubishi Advanced Technical Research Center. This is a continuation of work reported at the previous two ICCF conferences. They have made considerable progress. The experimental apparatus is a multimillion dollar instrument installed in a clean room. In six out of six experiments, they detected excess heat, x-rays and transmutations. This is a unique cathode, with layers of palladium and calcium oxide. Deuterium is loaded on one side electrolytically, and then sucked through the cathode into a vacuum chamber.

[snip]

DETECTION OF ANOMALOUS ELEMENTS, X-RAY AND EXCESS HEAT INDUCED BY CONTINUOUS DIFFUSION OF DEUTERIUM THROUGH MULTI-LAYER CATHODE (Pd/CaO/Pd)

[snip]

It was

demonstrated by the experimental results that CaO was one of the elements which can induce nuclear reactions and it was necessary that CaO exists at the near surface of Pd. Different elements such as Zn or Pb, in addition to Ti, Si, Cu or Fe were also detected on the surfaces of the multi-layer cathodes.

CaO strikes again!

Another post by Jed Rothwell follows.

October 1, 2003 2:08:41 PM AKDT

Brothers and Sisters! A bounty of new ICCF-10 papers are available:

<http://lenr-canr.org/iccf10/iccf10.htm#Proceedings>

Included are some important ones by Steve Jones et al., featuring snide comments in the introductory paragraphs. Important but snide.

Verily, today's downloads were 1,741. But we have only eight more days!!!

Tomorrow I hope to upload:

Higashiyama, Y., et al. Replication of MHI transmutation experiment by D2 gas permeation through Pd complex. in Tenth International Conference on Cold Fusion. 2003. Cambridge, MA: LENR-CANR.org.

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It begins:

"Unusual nuclear transmutation reactions have been reported by Mitsubishi Heavy Industries (MHI). In their experiment, D₂ gas permeates through a Pd complexes, which consists of a thin Pd layer, alternating CaO and Pd layers and bulk Pd. When they used sample Pd complexes with additional Cs on the surface, Pr emerged on the surface while Cs decreased after the sample was subjected to D₂ gas permeation at 343 K and 1 atm for about one week. The elemental analysis was performed by X-ray photoelectron spectroscopy (XPS). This phenomenon was reproduced qualitatively in the present replication experiment.

We performed D-permeation experiments similar to the MHI s experiment three times, and we confirmed the production of Pr. Pd complex samples were provided to us by MHI. The surface was electrolytically cleaned to remove hydrocarbons before depositing Cs. D₂ gas was permeated through the Pd complexes at 343 K and 1 atm for about 5 days. Inductively Coupled Plasma Mass Spectrometry (ICP-MS) was performed to analyze the existence of the elements (Cs and Pr) and the mass distribution. The results showed the existence of Pr. And we also confirmed the existence of Pr by using fast Neutron Activation Analysis (NAA) in FNS of Japan Atomic Energy Research Institute (JAERI).

As a result, we confirmed that the nuclear transmutation reaction, from ¹³³Cs to ¹⁴¹Pr, has occurred. . . ."

The Japan Atomic Energy Research Institute (JAERI) is supposedly one of the biggest, most prestigious nuclear physics labs in Japan. This is like a confirmation at Los Alamos. Wow!

- Jed

Note - some material here posted under the topic "A Simple Idea". Also, under "Anode Blue Glow", 2/1/2004:

Some time ago I reported here observing a blue glow about the anode in high voltage electrolysis/electrospark experiments. This was observed in CaO electrolyte and others, once the electrodes were "conditioned" a while by running AC through them. In the course of conditioning the electrode a rectifying film is

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produced, which in the case of two identical electrodes produces in effect a capacitive element in the circuit, i.e. the opposition of two diodes in series. This capacitive element is breached at a sufficient voltage, and there is a current vs voltage curve that suggests a statistical effect, namely the tunneling of electrons through the barrier. When the conditioning is complete, and DC current is used, the blue or blue-green glow can be seen on the anode surface, especially when the anode has a large surface and the cathode an equal or smaller surface. In my experiments the objective was to generate electrosark or cathode sheaths at the cathode, so typically the cathode was smaller than or the same size as the anode. The blue glow on the anode was a surprise.

The onset of this glow in significant brightness was observed in CaO electrolyte at fairly high voltages, i.e. over 400 V.

The free energy list has a reference to the following:

<<http://home.earthlink.net/~lenyr/borax.htm>>

which discusses the use of borax electrolyte and ordinary baking soda to achieve an anode glow at less than household voltage (120 V). It should be interesting to see what develops there.

For more on blue glow see:

<<http://www.mtaonline.net/~hheffner/GlowExper.pdf>>.

Acknowledgment:

The experimental work on Electrosark generation and calorimetry done in 1997-1998 was accomplished only with and as a result of the generous tutelage, encouragement, and even material assistance of EarthTech International Inc. of Austin Texas, and in particular Scott Little of EarthTech. His continued tolerance of and assistance to this amateur has been greatly appreciated.