

EXCESS POWER PRODUCTION FROM PLATINUM CATHODES USING THE PONS-FLEISCHMANN EFFECT

Edmund Storms

Energy K. Systems, 2140 Paseo Ponderosa, Santa Fe, NM 87501

ABSTRACT

Excess power was produced using a platinum cathode. Efforts to produce active cathodes by plating palladium onto various metals were largely unsuccessful.

INTRODUCTION

Palladium has been the cathode of choice since Pons and Fleischmann made their original claims. Occasionally, anomalous energy has been claimed to result from other elements such as Pt[1; 2], Au[3], Ti[4]. Thin layers of palladium on various inert substrates have also been claimed to produce anomalous energy [5; 6; 7; 8]. From this collection of experience, one might conclude that any layer of Pd made to stick tightly to the surface of another material would produce energy with greater ease than the bulk metal. This assumption has been found to be false even though such material can achieve a D/Pd ratio greater than 1.5[9]. Layers of electroplated Pd can be just as difficult to reproduce as bulk material. Although several successful samples were made, this paper will describe only one example of uncoated platinum which produced excess energy after being electrolyzed for an extended time in LiOD+D₂O.

EXPERIMENTAL

Calorimeter Design:

The calorimeter, shown in Fig. 1, consists of a Pyrex glass cell surrounded by a water-cooled jacket. This assembly is contained in a vacuum dewar, thereby allowing most of the energy lost through the lid to be picked up by the cooling water. A magnetic stirrer is used to stir the electrolyte, thereby reducing temperature gradients. The entire assembly along with all reference resistors is contained in a constant temperature environment. Table I lists values and uncertainties for the various quantities.

The electrolytic cell contains three linear thermistors within the electrolyte, one near the top of the solution, one near the bottom, and the third just above the cathode. The anode is equidistant (0.5 cm) from the flat plate cathode (1 cm x 2 cm). Temperature of distilled water flowing through the jacket is measured just as it enters the jacket and just as it leaves. Data are recorded every 15 min. using a National Instruments data acquisition system after averaging 15000 values. The flow rate is measured by allowing the water after it leaves the calorimeter to fill a container on a balance while the weight and time are recorded every 120 sec. In addition, the cell contains a Pt-coated-carbon recombiner catalyst and an exposed Pt wire heater for calibration. Luggin capillaries allow the voltage between a platinum reference electrode and the cathode to be measured. Because the cell is connected to an oil reservoir, any gas generated within the cell can be detected by weighing the oil displaced onto a balance. Samples can be quickly changed or replaced by an inert cathode for calibration. Lengthy studies of inert platinum show a stability of ± 75 mW.

Calibration and Error

A typical calibration for the flow-mode is shown in Fig. 2, using a clean piece of platinum for the cathode. Values are taken both going up and going down in applied power in

the same manner as the sweeps described later. The standard deviation of the electrolytic values from the least-squares line is ± 30 mW which is the same as the standard deviation from a constant value when stable excess energy is being observed at low applied power.

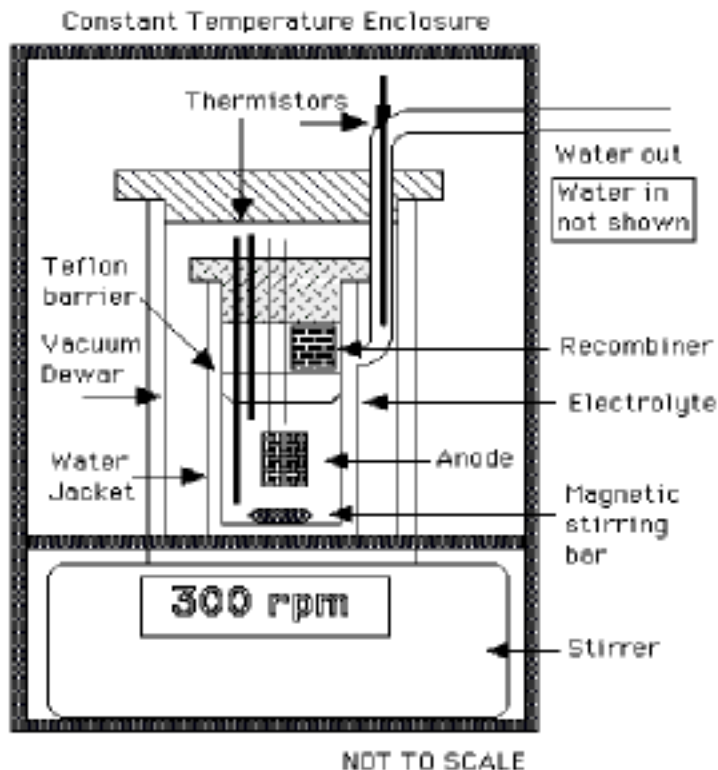


Figure 1. Drawing of the calorimeter. The electrolyte is 65 ml of 0.3 N LiOD and the anode is Pt mesh. The cell lid is Lucite and the Dewar lid is expanded foam insulation. All thermistors are glass covered. Time to reach a steady temperature is 50 min.

TABLE I
Summary of uncertainties in measured quantities

Water temperature entering the jacket = $20 \pm 0.02^\circ$
 Environment temperature = $20 \pm 0.03^\circ$
 Flow rate = 31.00 ± 0.05 g/min (long term variation)
 Precision of current measurement = $\pm < 0.001$ A
 Precision of voltage measurement = $\pm < 0.001$ V
 Precision of temperature measurement = $\pm < 0.005^\circ$
 Absolute accuracy of temperature measurement = 0.1°
 Stirring rate = $300 \text{ rpm} \pm 1 \text{ rpm}$
 Average heat capture efficiency = $98 \pm 0.5\%$

This scatter increases to ± 0.1 W at the upper limit of applied power (27 W). A zero drift as much as -0.05 W has been observed over an extended time. Consequently, changes in excess energy production are more accurate than absolute values. Good agreement between the electrolytic- and Joule-based calibrations shows that the location of heat production does not affect the accuracy of the device. Doubling the fluid flow from 22.3 g/min to 45.3 g/min caused a change in the calibration constant from 0.0732 W/degree-g/min to

0.0738 W/degree-g/min, indicating that good thermal mixing is achieved in the exiting cooling water. Because samples can be easily changed, the cathode is frequently replaced by clean platinum when the need arises to recalibrate. Good stability is shown by a scatter of only $\pm 1.6\%$ in the calibration constant when measured many times over three months.

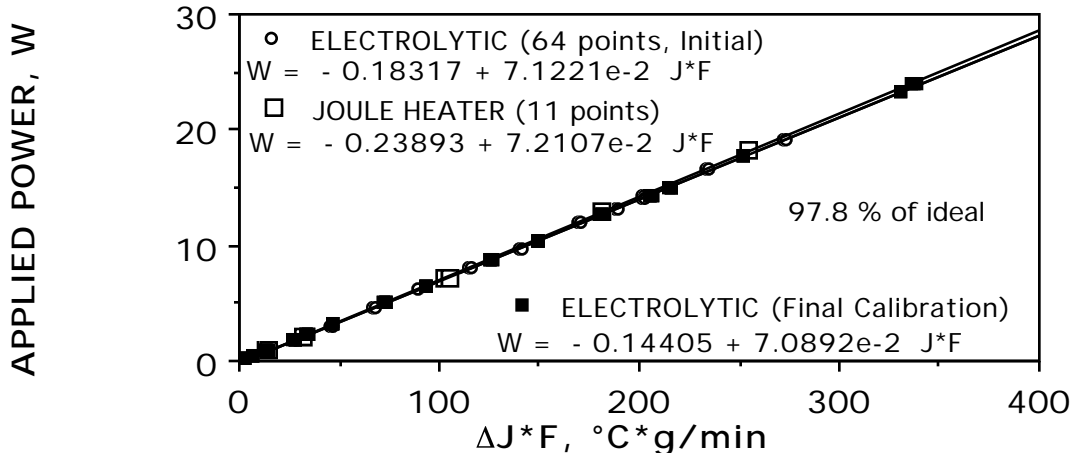


Figure 2. Comparison between electrolytic and heater calibrations before and after the study using the flow method. The heater and electrolysis agree within 1.2%.

The cell can also be used as a rough isoperibolic calorimeter by measuring the average temperature between the electrolyte and the cooling jacket. However, this method is not stable, in spite of active stirring, because of changes in the convection currents in the electrolyte and in the jacket. Figure 3 shows how the average temperature across the jacket changed between the first and final calibration using the electrolytic method and clean Pt.

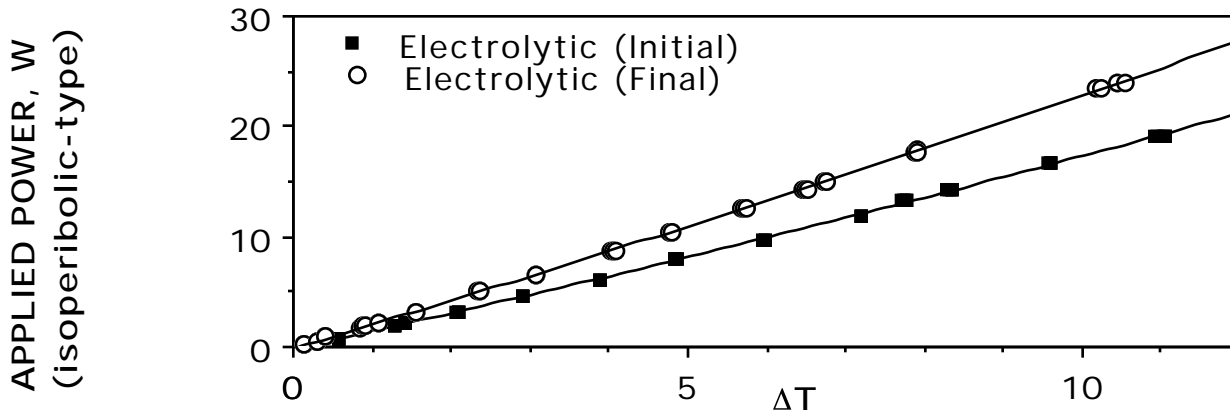


Figure 3. Comparison between applied electrolytic watts and the average temperature across the jacket for two calibration runs.

Excess Energy Measurement

Figures 4, 5, and 6 show the time history for excess power (EP) production using a special platinum cathode. Current sweeps consist of stepping the current up in value, waiting for the calorimeter to achieve steady-state (50 min), taking five values, and repeating the process. After reaching 3 A, the current is reduced in steps. Notice in Fig. 4 that the expected EP was achieved at 0.5 A and 1.0 A, but decayed away when 1.5 A was applied. A sweep taken after the decay showed very little EP. After the current was turned off for a brief time, the study was resumed in Fig. 5. Notice that the EP again gradually increased after 0.5A was applied. Sweep #3 again showed EP and this continued while 0.75A and 1.0A were applied. However, application of 1.5A again caused the EP to decay away.

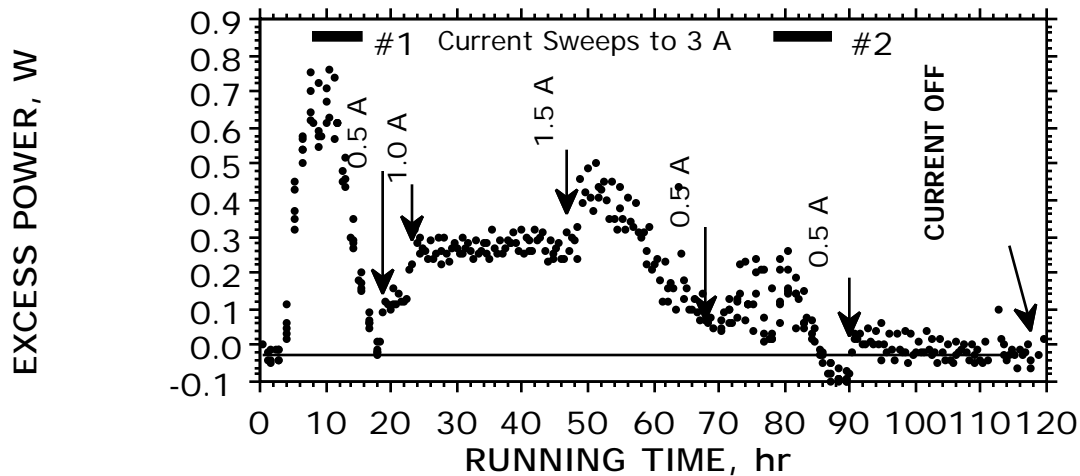


Figure 4. Time history of excess power production from a Pt sample.

Once again the current was turned off. Application of 0.5 A, shown in Fig. 6, again showed EP. The calorimeter was calibrated at 430 h using the internal heater and later using an inert Pt cathode. This experience shows a consistent pattern of behavior which was repeated once again, but is not shown here.

The first sweep is shown as applied current vs EP in Fig. 7. Notice that excess power is indicated by the isoperibolic method during this initial sweep, but later sweeps do not show an effect because of a change in calibration, as indicated in Fig. 3. Also notice that the excess power falls on a higher line upon reduction in applied current. Subsequent cycles, as shown in Fig. 8, produce excess power that fall on this higher line. The final relationship is linear and extrapolates to zero EP at zero applied current, in contrast to the behavior of palladium, which requires a critical applied current before EP is produced. Figure 9 shows the sweeps taken later using different numbers of values to produce the plotted average and these are compared to the heater calibration.

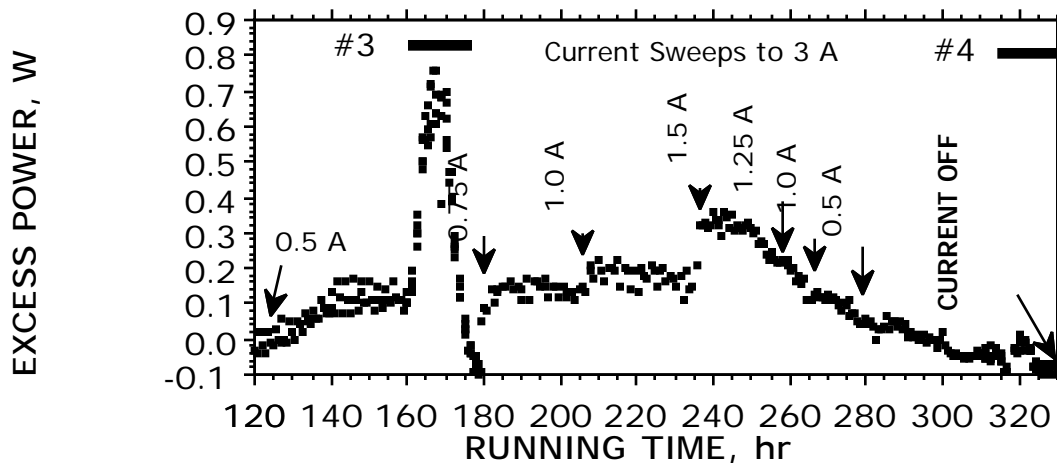


Figure 5. Time history of excess power production from a Pt sample.

DISCUSSION

A large average composition within the cathode is thought required to produce excess energy. Yet many researchers have failed to produce excess power after achieving large compositions, for example Nakata et al.[10]. Now, metals that do not even dissolve hydrogen are found to make excess energy. Clearly, additional variables are operating.

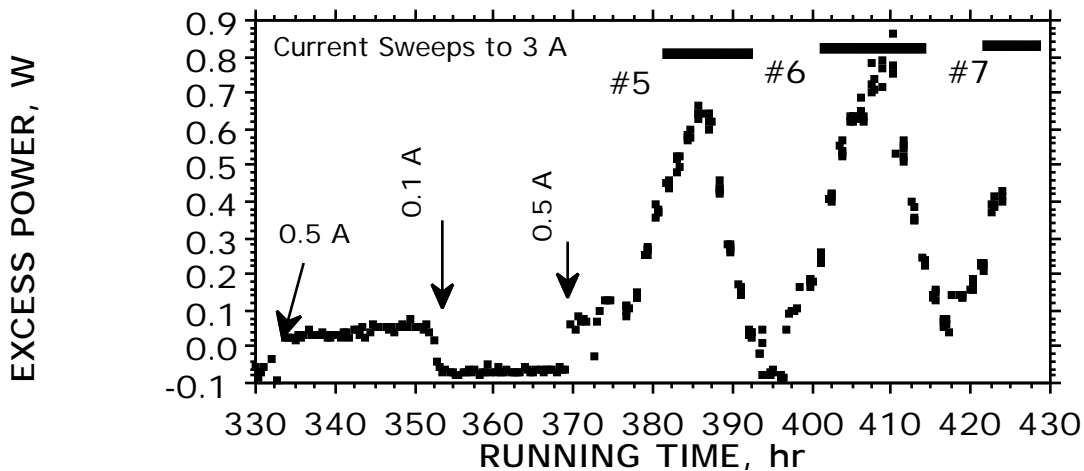


Figure 6. Time history of excess power production from a Pt sample.

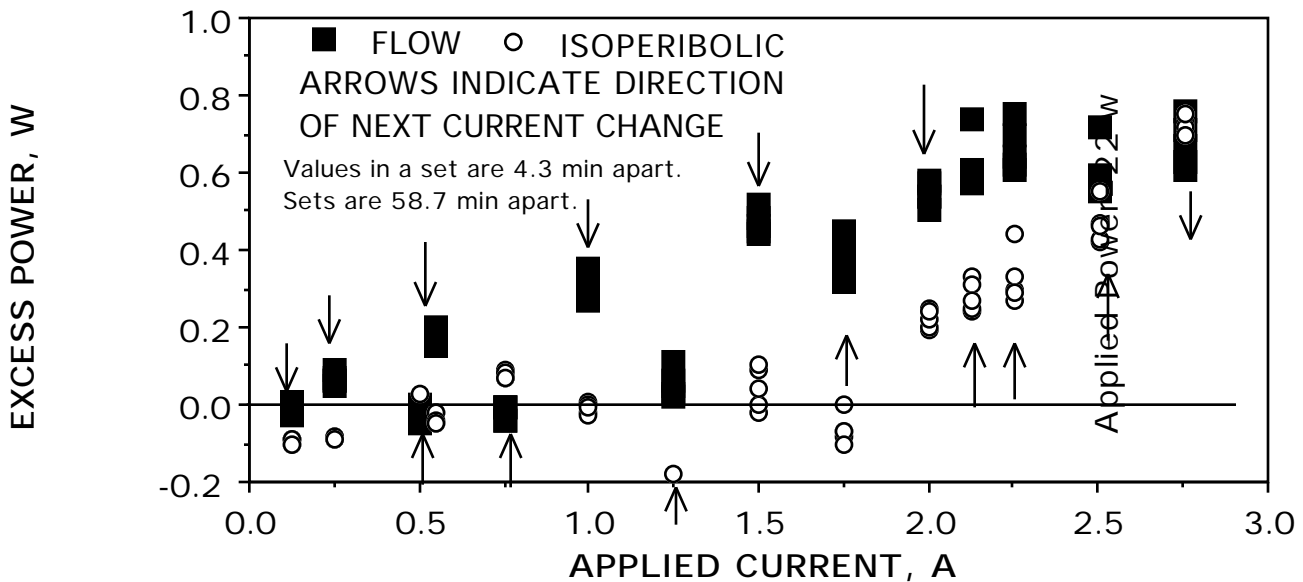


Figure 7. Comparison between excess energy measured using flow method and isoperibolic method during first current sweep.

In the case of platinum, this study suggests that an energy-active layer of unknown composition can deposit on a Pt surface. This observation might also be related to the frequent detection of Pt on the Pd cathode after excess energy is observed. Such a layer is slow to form, which is consistent with the observed long delay in producing excess energy, and, for this sample, it is unstable. Is it possible that such a layer might be the active material in all studies, even when palladium is used? McKubre et al. [11] also suggest that a critical layer is required to maintain the required high composition in Pd. Perhaps this is the actual active material. If this is the case, the bulk properties of palladium are only important in that they must support a critical concentration within this layer. Since palladium can easily permit loss into the metal, such material might be the worst substrate to use. Platinum, gold, and other inert materials would appear to be better choices. Use of such materials would only require forming the active layer without a need to use special batches of the substrate. If this suggestion is true, significant changes in various theories will be required.

More detail and the raw data can be accessed at <http://jedrothwell.home.mind-spring.com>.

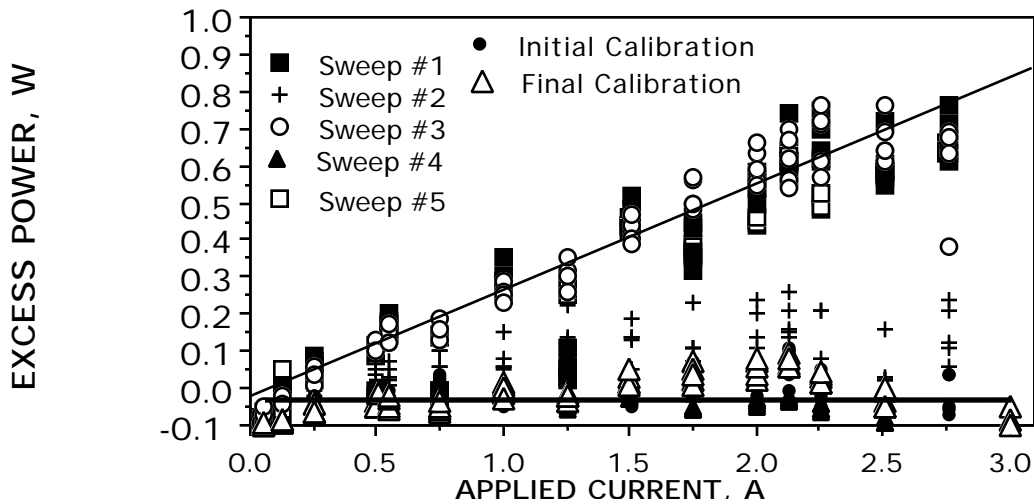


Figure 8. Applied current vs excess power for the various sweeps, compared to Pt calibrations taken before and after the study.

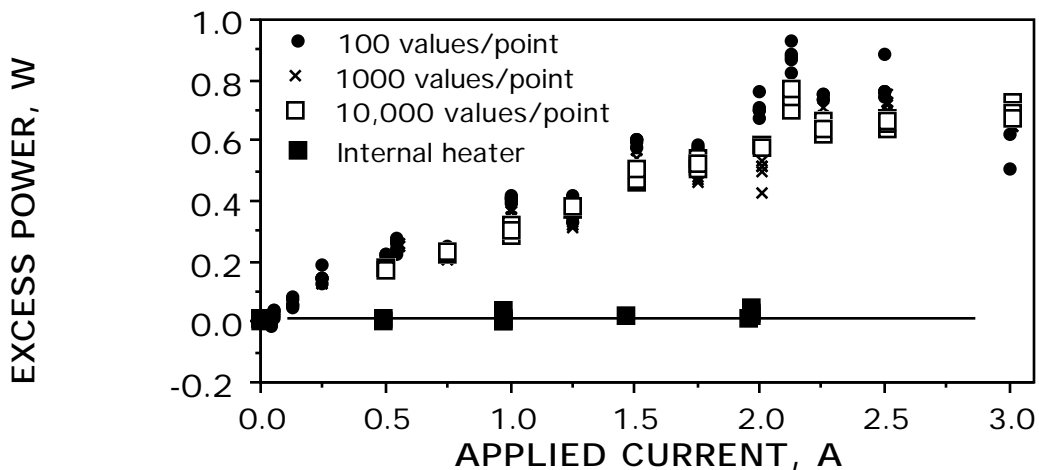


Figure 9. Applied current vs excess power for sweeps using different number of values to average are compared to the heater calibration.

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