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VALIDATION REPORT

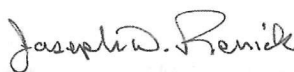
Bomb and Water-Flow Calorimetry Experiments

Performed by Brilliant Light Power, Inc.

April 22-23, 2016

Respectfully submitted

June 6, 2016

A handwritten signature in black ink that reads "Joseph D. Renick". The signature is written in a cursive style with a large, stylized 'J' and 'R'.

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INTRODUCTION

On April 22 and 23 I visited the laboratories of Brilliant Light Power (BrLP) in Cranbury, NJ along with Dr. Nick Glumac from UIUC for the purpose of observing experiments performed by BrLP personnel based on discovery by Dr. Mills of a means for catalyzing the transition of atomic hydrogen from the ground state to fractional quantum states. This transition results in the release of extraordinary amounts of energy in the form of thermal energy and electromagnetic emissions. The purpose of this investigation was to focus on the validity of the novel techniques, processes and materials being developed by BrLP as a new energy source for electrical power production. The main feature of these experiments is the initiation of the energetic process through discharge of a high current through a conductive medium within a highly specific chemical environment whereby normal physical and chemical processes result in the unique conditions required to catalyze the transition of atomic hydrogen to the $H(1/4)$ hydrino state. The catalyst employed in these experiments was HOH which is formed as an intermediate species during the event through conventional physical and chemical processes.

Both Calorimetry and Spectroscopy experiments were performed. This report addresses only the Calorimetry experiments.

BOMB CALORIMETRY EXPERIMENTS

Seven experiments were conducted in a Parr 1341 calorimeter modified to accommodate a bomb configured to test solid fuel samples in environments representative of those proposed for application in BrLP's Sun Cell[®] electrical power generator. Figure 1 (provided by BrLP) describes the experimental configuration. The solid fuel is a nominally 66 mg pellet in the form of a thin cylindrical disc composed of Ag and (1 mole %) which is held under compressive pre-load between the electrodes to assure good electrical contact. In each case the pellets were prepared the day before the experiment in which they were tested.

The bomb was filled with a mixture of Ar/H_2 at 95/5 mole fractions and 1 atmosphere pressure. The Ag provides the conductive medium for the high current discharge, the provides the oxygen and the H_2 provides the hydrogen. The purpose of the Ar is to dilute the hydrogen concentration in the gas mixture which increases the half-life of atomic hydrogen in its recombination to its preferred molecular form which increases hydrino formation and the energetics of the reaction. Four trials were conducted for the solid fuel pellets where the only variability between experiments was the slight variation in mass of the pellets (about +/- 5%) incurred during preparation and in one trial, MY3, an MgO crucible was used in preparation of the test pellets rather than graphite.

Two control experiments were conducted where tungsten foil was substituted for the standard pellet and a single experiment was conducted with an empty sealed aluminum DSC pan. Each of the control experiments were conducted under an atmosphere of pure argon. I also incorporated in my analysis the results of two additional tungsten control experiments, both conducted on April 26 and an additional DSC pan test conducted on April 21.

The solid fuel pellet is initiated by a single cycle 60 Hz high current (~20,000 amps) low voltage (<10 volts) discharge from a commercial spot welder. Upon discharge, the pellet is vaporized and ionized

Energetic Experiments

The results of two experiments, 2016-04-22-MY5 included in Table 1, and a previous experiment 2016-04-13-MY1 (not included in Table 1) exhibited substantial differences in net energy density, 2569 J/g and 3764 J/g respectively. 2016-04-13-MY1 seemed to be an outlier on the high side while 2016-04-22-MY5 was more representative of the other energetic experiments in Table 1 where the average energy density of those four experiments was 2312 J/g. I thought that because of the large difference in output energy between these two experiments that it would be interesting to compare their VI power input characteristics to determine if there might be a correlation of differences in energy output to difference in power inputs. Those results are shown in Figure 2 where voltage, current and VI inputs for the two experiments are over-plotted for comparison. There is not much to be said here other than the obvious. (1) The power characteristics between the two events are quite similar. (2) Minor differences in peak voltage and current integrate to only modest differences in total energy delivered to the test pellet. (3) The time-dependent behavior of the power source and the behavior during the rapid transition to an open circuit is quite repeatable. A cursory examination of the time-dependent power inputs for other such experiments exhibited similar properties in every respect. There was nothing regarding the current discharge in these two experiments that might suggest a correlation between energy of the power pulse and thermal energy produced.

In Figure 2 the zero current and voltage starting at data point 401 and continuing for approximately another 100 data points is assumed to be a characteristic of the power supply with no significant impact on the results.

Average net energy density for these experiments was 2245 J/g with a spread of roughly +/- 15%.

Summary

The tungsten control experiments confirm the basic reliability of the experimental and analytical methods of the calorimetry experiments.

The effects of the large copper electrodes that provide a path for transfer of heat from the bomb to the environment are treated in the basic Parr analysis methodology through consideration of the pre and post cooling/heating rates.

Because of the magnitude of the power corrections required, roughly 50%, it was crucial that this correction methodology be experimentally confirmed. The consistency of results between the tungsten, DSC pan and Ag- experiments confirm the validity of the basic methodology for correcting the measured power input to account for the reactive component due to the abrupt opening of the circuit.

Finally, the results of these experiments support the existence of a new source of energy based on the ability to catalyze transitions of atomic hydrogen to fractional quantum states through well-understood and uncontroversial physical and chemical processes.

where the rapidly expanding plasma mixes with the argon-hydrogen atmosphere. The hydrino transition is then catalyzed by the formation of the HOH intermediate.

Current (I) and voltage (V) measurements provide a measure of the input power which must be accounted for in the energy balance. The explosive vaporization of the test pellet breaks the electrical contact between the electrodes disrupting the input power. The dynamics of this rapid transition (about 10 μ s) to an open circuit results in a reactive power component in the VI data that must be considered in the energy balance. In my analysis I did not give any consideration to the validity of the theoretical basis for how that component of energy was treated, however, I did look to the experimental results to see if those results provided any indication of the validity of that treatment. I also noted that the correction factor or ratio of corrected total energy input to that measured, $\int VI dt$, varied depending on the sample to be tested. For the Ag- pellets the correction factor was about 0.54. For the DSC pan the correction factor was about 0.84 and for other experiments conducted on April 27 using Ag- pellets the correction factor was also about 0.54. For the tungsten events there was no power disruption and thus the correction factor was 1.

An additional consideration was concern over the thermal energy transfer that occurs because of the rather large copper electrodes which provide a direct path for thermal heat transfer from the bomb to the ambient environment. Further, the response of the calorimeter in these experiments was typically 6 minutes allowing considerable time for heat transfer. Upon examination of the standard Parr data analysis process I concluded that the effect of the electrodes is automatically accounted for in the pre and post event heating/cooling rates as simply their contribution to the overall thermal characteristic of the calorimeter. No additional correction is required. Based on an average of pre and post event cooling rates it is estimated that the magnitude of the correction could be around +15% where the thermal energy generated in the bomb is greater than that indicated by temperature measurements alone. Again, the standard Parr analysis process accounts for the heat conduction effect of the electrodes.

Tabulated results for each experiment are shown in Table 1.

Control Experiments

In the four tungsten control experiments there was no explosive event between the electrodes and thus no rapid transition to an open circuit in the power system therefore there was no need for a power correction. The average of the net energy measured in these events (theoretically zero) was 1.0025 J +/- 10 J (roughly). Given that the average input energy was 275 J, the percent error assuming no energetics in these events is 0.4% with a variability in results of roughly +/- 4%. Given the small sample space the confidence level is not high but nevertheless, the results are encouraging if not impressive. There is nothing in these experiments that gives cause for concern about the basic calorimetry methods employed.

For the two DSC pan experiments, because the aluminum pan undergoes explosive vaporization, rapid transition to an open circuit occurs thus a power correction was necessary. The average *Power Fitted Net* energy (net output energy after correction in input power) was 6.1 +/- 19 J. Average corrected input power was 273 J. The average error referenced to the average input power and assuming no energetics in the bomb is 2.2% with a variability in results of roughly +/- 7%. Again, while the small sample space greatly limits confidence level in the results, the results indicate that the method for calculating the adjusted power is correct.

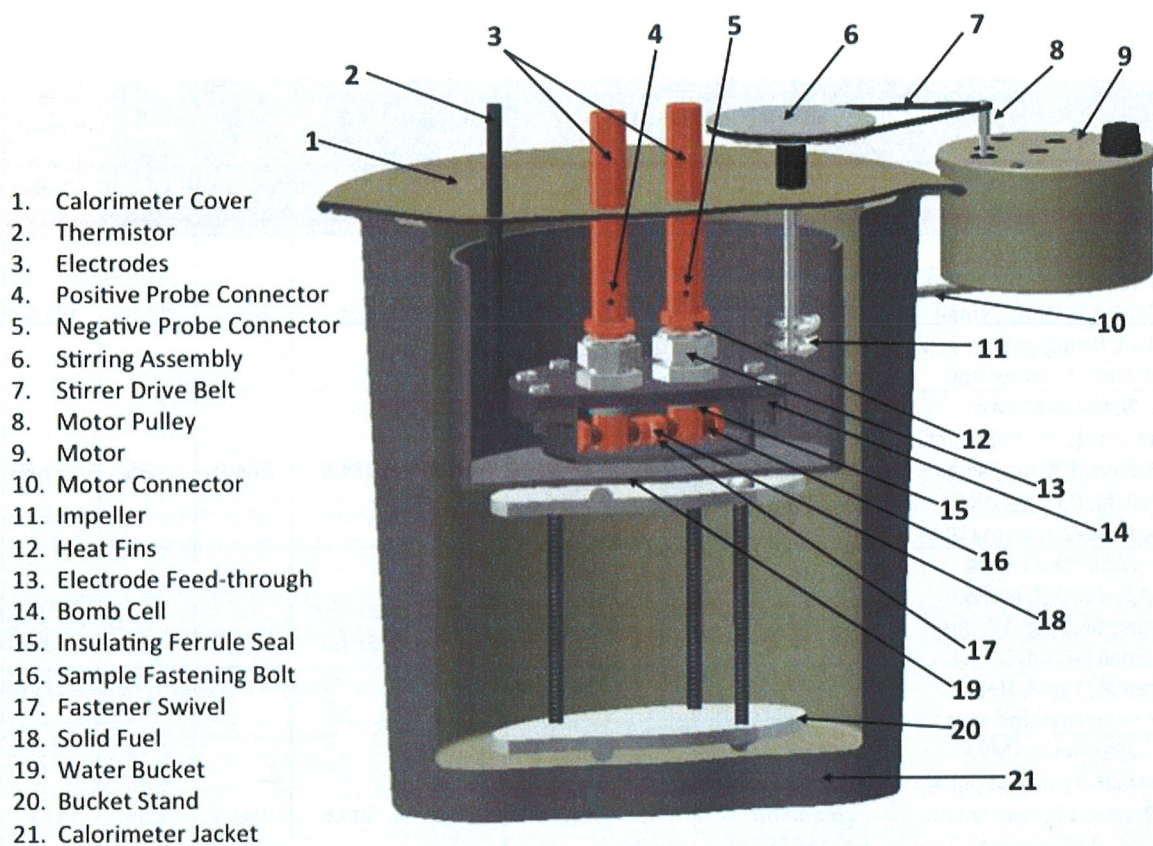


Figure 1. Configuration of Parr 1341 calorimeter and bomb for energetic and control experiments.

Table 1. Summary of Calorimetry Data

Sample	Purpose	Purge	Total dT (°C)	Parr Calc'd dT (°C)	Thermal Energy Out (J)	VI Power Fitted (J)	VI Power Fitted Gain (X)	VI Power Fitted Net (J)	Net Energy (J/g)
2016-04-23-MY1 Ag+ (1 mol%) pellet, 69.2mg, 175 lbs., small cell #4, 0-ring gasket, Tap 8, Heat 1, screw tips	Test Ag + (1mol%) pellet made on 042216CC1 in graphite crucible	5min H5 purge	0.0540	0.0608	389.4	245.8	1.58	143.5	2074
2016-04-22-MY5 Ag+ (1 mol%) pellet, 66.8mg, 175 lbs., small cell #4, 0-ring gasket, Tap8, Heat 1, screw tips	Test Ag + (1mol%) pellet made on 042116RF2 in graphite crucible	5min H5 purge	0.0510	0.0585	374.5	203.0	1.85	171.6	2568
2016-04-22-MY4 Ag+ (1 mol%) pellet, 66.8mg, 175 lbs., small cell #4, 0-ring gasket, Tap 8, Heat 1, screw tips	Test Ag + (1mol%) pellet made on 042116RF2 in graphite crucible	5min H5 purge	0.0510	0.0569	364.0	200.3	1.82	163.6	2450
2016-04-22-MY3 Ag+ (1 mol%) pellet, 62.1mg, 175 lbs., small cell #4, 0-ring gasket, Tap 8, Heat1, screw tips	Test Ag + (1mol%) pellet made on 042116RF2 in MgO crucible	5min H5 purge	0.0490	0.0484	309.6	198.1	1.56	111.5	1887

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Table 1. Summary of Calorimetry Data (concluded)

Sample	Purpose	Purge	Total dT (°C)	Parr Calc'd dT (°C)	Thermal Energy Out (J)	VI Power Fitted (J)	VI Power Fitted Gain (X)	VI Power Fitted Net (J)	Net Energy (J/g)
2016-04-22-MY6 Empty Setaram pan w/lid (Baked at 300C for 30 min), 53 lbs., small cell #4, o-ring gasket, Std. Cu caps, Loaded in Argon GB, Tap 8, Heat 1	Test empty Setaram pan (Baked at 300C for 30min) under Argon	Ar GB	0.0380	0.0475	304.2	282.0	1.08	22.2	
2016-04-21-MY1 Empty Setaram pan w/lid (Baked at 300C for 30 min), 60 lbs., small cell #4, o-ring gasket, Std. Cu caps, Loaded in Argon GB, Tap 8, Heat 1	Test empty Setaram pan (Baked at 300C for 30min) under Argon	Ar GB	0.0300	0.0389	248.9	264.8	0.94	-15.9	
2016-04-26-MY6 W foil control, 225 lbs., small cell , Heat 1, flat Cu caps	Test W foil control	Ar purge	0.0360	0.0401	256.8	257.0	1.00	-0.2	
2016-04-26-MY5 W foil control, 225 lbs., small cell , Heat 1, flat Cu caps	Test W foil control	Ar purge	0.0390	0.0460	294.2	304.0	0.97	-9.8	
2016-04-22-MY2 W foil control, 225 lbs., small cell , Heat 1, flat Cu caps	Test W foil control	Ar purge	0.0350	0.0402	257.5	246.0	1.05	11.5	
2016-04-22-MY1 W foil control, 225 lbs., small cell , Heat 1, flat Cu caps	Test W foil control	Ar purge	0.0400	0.0456	291.8	294.0	0.99	-2.2	

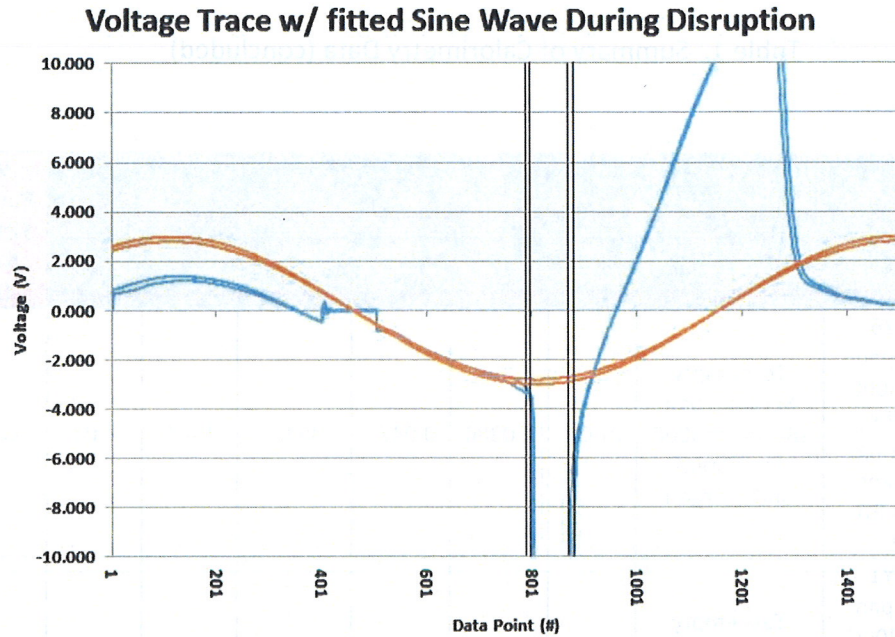


Figure 2 (a). Comparison of power input (voltage) for 2016-04-13-MY1 in which 251 J total input energy resulted in 3764 J/g net thermal energy and 2016-04-22-MY5 in which 203 J total input energy resulted in 2567 J/g net thermal energy.

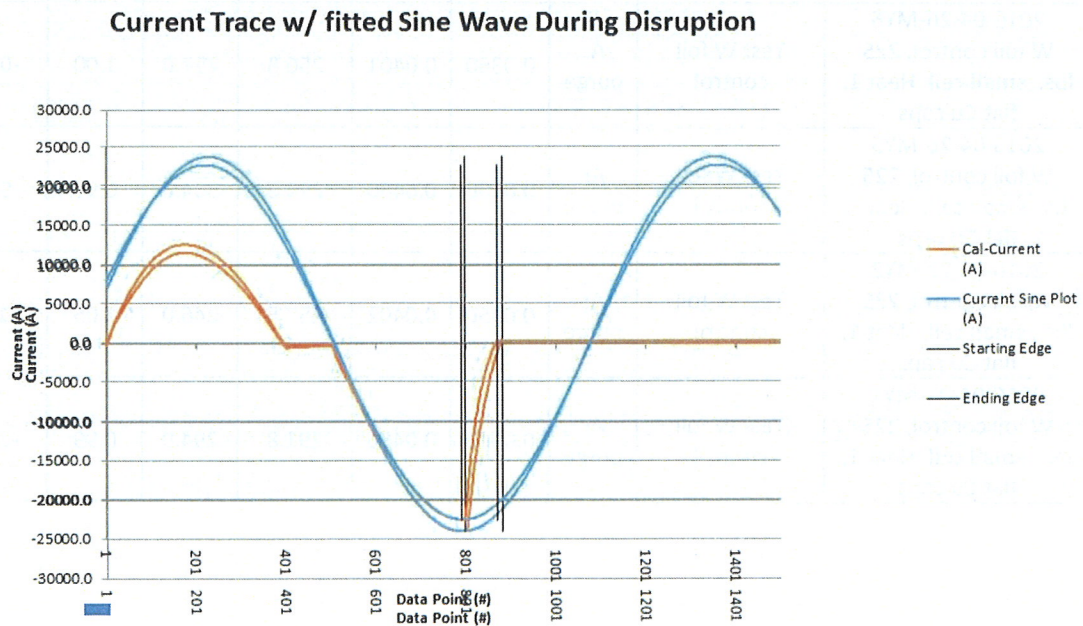


Figure 2 (b). Comparison of power input (current) for 2016-04-13-MY1 in which 251 J total input energy resulted in 3764 J/g net thermal energy and 2016-04-22-MY5 in which 203 J total input energy resulted in 2567 J/g net thermal energy.

Power Trace w/ fitted Sine Wave during Disruption

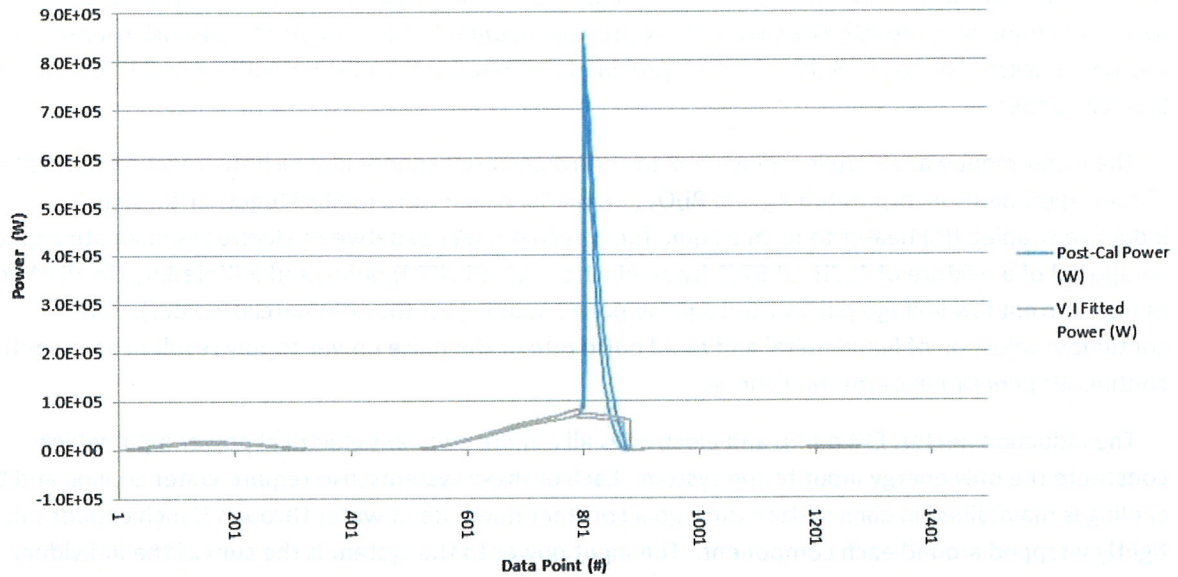


Figure 2 (c). Comparison of power input (VI) for 2016-04-13-MY1 in which 251 J total input energy resulted in 3764 J/g net thermal energy and 2016-04-22-MY5 in which 203 J total input energy resulted in 2567 J/g net thermal energy.

CG WATER-FLOW CALORIMETRY

BrLP provided a demonstration of the operation of their basic SunCell® hydrino reactor configured for water-flow calorimetry. This validation study is based on the information provided by BrLP at the demonstration, the CONFIDENTIAL paper they provided (*SunCell® Thermal Burst Power Measurement*) and data package for 2016-04-19-CG which provided the data for the event identified as 042016DR in the SunCell® paper.

The experiment was set up in a glove box to control the atmosphere in which the reaction takes place. These experiments incorporated Ag and (1 mole %) which were melted together through an inductive coupled (IC) heater to form a liquid fuel which is injected between electrodes in an atmosphere composed of a mixture of Ag/H₂ at 97/3 by an electromagnetic (EM) pump and initiated by the discharge of high current low voltage pulses from a pulse power supply (not the commercial welder). The continuous injection of liquid metal and rapid pulse rate of the pulse power supply result in an essentially continuous generation of thermal energy.

The induction heater, EM pump and electrodes all require constant electrical power input which constitute the only energy input to the system. Each of these systems also require water cooling and that cooling is maintained in each system through a constant flow rate of water through ¼ inch copper tubing tightly wrapped around each component. The input power to the system is the sum of the individual voltage-current products.

The only other thermal mechanisms at work in the cell are power generation through hydrino formation and heat transfer to the environment. There are no phase change or chemical reactions to account for other than those associated with the hydrino reaction itself. The only other form of energy in the system is the relatively small level of kinetic energy of the injected molten silver mixture and the water flowing in the cooling system and these are assumed to be constant throughout cell operation for both pre-ignition and post-ignitions conditions.

The cell is operated initially in a non-reactive mode by injecting pure silver between the electrodes instead of the silver mixture. By operating the cell in the non-reactive mode under steady state conditions a thermal calibration of the system can be realized where the total input electrical power provides the calibration standard for water-flow calorimetry. A nice aspect of this experiment is that its characterization depends on heating rate rather than temperature difference. Consequently, the only measurements required are input power to the IC heater, EM pump and electrodes, and temperature measurements in the antenna coil of the cooling system for the IC heater which directly registers thermal output of the reactor.

Analysis

The thermodynamics for water-flow calorimetry as applied here are straightforward where the energy balance equation is easily derived from a consideration of the input and output energies. The net output power is simply the total output power as determined by the temperature increase in the antenna coil less the input power to the IC heater, EM pump and electrodes.

We provide detailed examination of the 042016DR event. Plots of the antenna cooling loop thermal response are shown in Figures 3, 4 and 5. In Figure 3 the entire time-history of the event is shown. In

Figure 4 that plot is expanded to provide a better resolution of the pre-ignition heating which registers effects of the IC heater and EM pump input power. In Figure 5 the plot is expanded to provide good resolution of the time-history just before and after ignition.

In Figure 4 the heating due to power input for about 400 seconds prior to ignition is shown. While picking a section of this portion of the history is subjective, the slope during the last 150 seconds, identified as S1, seemed most appropriate because it immediately preceded ignition. S1 was measured at $0.00192\text{ }^{\circ}\text{C/s}$ and represents the heating effect on the system due to total power input to the IC heater and EM pump of 4300 W providing a calibration factor of 2,240,000 W-s/ $^{\circ}\text{C}$. Energy output after ignition can then be calculated as this factor times the slope of the temperature time-history.

The slope S1 could be adjusted to account for electrode power which results in a total input power of 7540 W. However, since the calibration factor must also reflect the new total power input the result is the same. Thus it is concluded that the calibration based on S1 is appropriate for all phases of reaction.

Figure 5 shows an expanded portion of the temperature time-history that shows temperature response due to two distinct energetic events. The first, S2, occurs before the mixing of [redacted] with the Ag (at this point pure molten silver is being pumped) and corresponds to interaction with the [redacted] ([redacted]) coating on the electrodes which provides the oxygen for the formation of the HOH intermediate which catalyzes the formation of $\text{H}(1/4)$. Slope of S2 was measured at $0.919\text{ }^{\circ}\text{C/s}$ yielding an output power of 2,052,000 W. The second power burst is due to the addition of the [redacted]. Here S3 is measured at a slope of $0.288\text{ }^{\circ}\text{C/s}$ resulting in a power output of 645,000 W. The values are nominally consistent with the results shown by BrLP in the reference paper of 2,576,000 W and 731,000 W, respectively. The differences almost certainly reflect the inherent subjectivity of determining the value of S1 and its direct effect on the calibration factor.

Summary

The purpose of this analysis was to evaluate the validity of the novel techniques, processes and materials developed by BrLP and their application in the design and operation of their SunCell® reactor. The subject CG experiment (and numerous other similar experiments) demonstrates the generation of extraordinary levels of thermal power. The net power output during the first phase of reaction was 2,044,460 W where the input power was only 0.4% of the output power and for the second phase the net output power was 637,460 W where the input power was only 1.2% of the output power.

The combination of the conceptual simplicity of the water-flow calorimetry methodology and the extraordinary power levels demonstrated provide high confidence levels in these results.

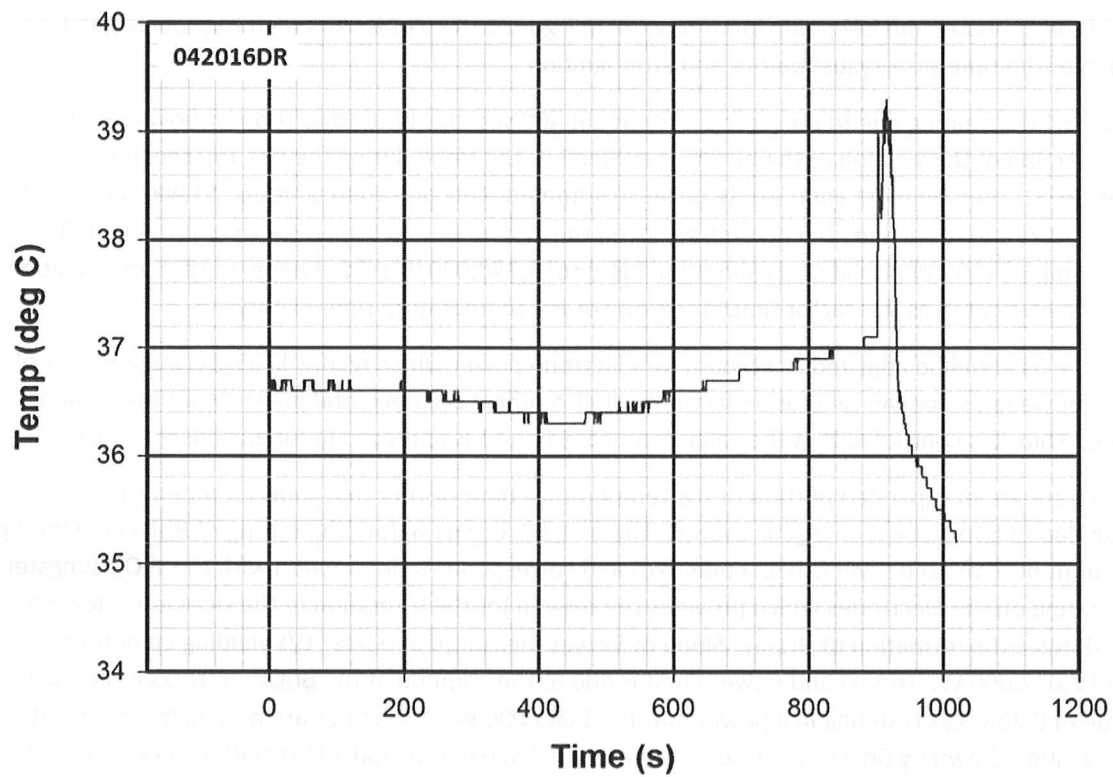


Figure 2. Temperature of antenna coil water, pre-ignition and ignition.

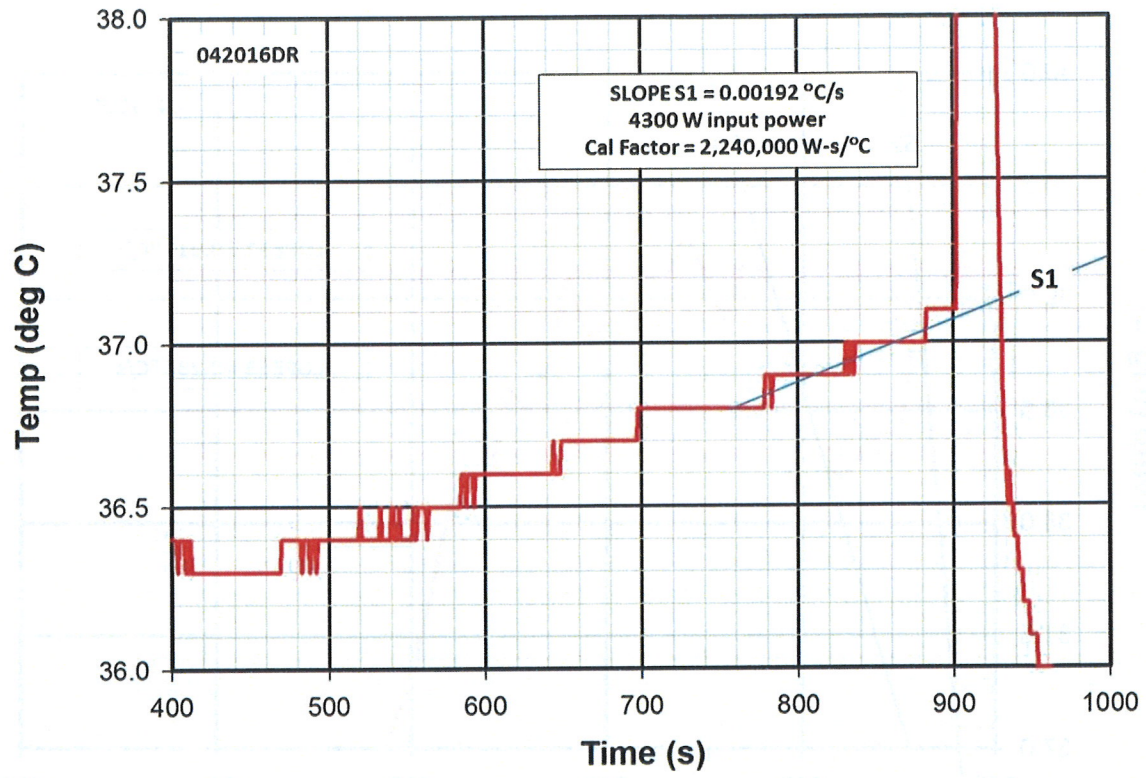


Figure 3. Heating due to IC heater and EM pump power input prior to ignition.

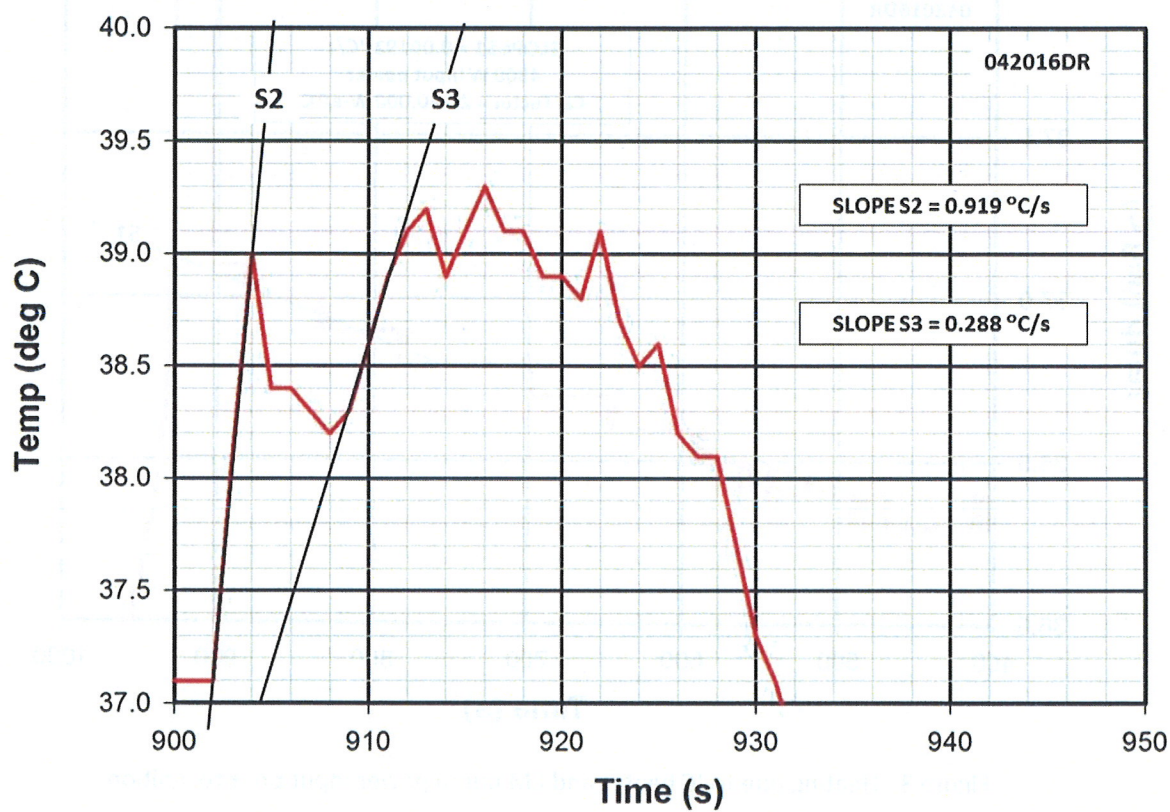


Figure 4. Expanded plot showing slopes of heating curves, reaction, reaction.