Catalyst Induced Hydrino Transition (CIHT) Electrochemical Cell Validation

Dr. Randell Mills of BlackLight Power, Inc. (BLP) has developed the "Grand Unification Theory of Classical Physics," based on applying physical laws and first principles rather than pure mathematics[1]. As a direct result of this theory, Dr Mills is able to calculate, with great precision, bond energies and molecular structures that have been verified through experimental observation and reported in the literature. The theory further predicts that there a more stable state of hydrogen than previously believed. He has identified this more stable state of hydrogen as the "hydrino." The predicted hydrino state should have a unique spectral signature and the catalytic/electrochemical reaction should also exhibit a continuum radiation and extraordinary fast H. Data has been published in leading physics journals confirming these[2][3][4][5][6]. A transition from hydrogen in the traditional molecular state, H_2, to the hydrino state will release energy two hundred times greater than burning the same hydrogen. BLP has invented a new electrochemical cell, the catalyst induced hydrino transition cell (CIHT), to harness this energy as direct electrical output.

The CIHT contains an anode, electrolyte and a cathode as indicated below. Atomic hydrogen is formed via initial electrolysis of water. That hydrogen is then converted via catalytic reaction to form hydrinos. The energy is captured as net electrical output of the CIHT.

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[1] R. Mills, *The Grand Unified Theory of Classical Physics*, July 2010 edition, http://www.blacklightpower.com/theory/bookdownload.shtml.

[2] R. L. Mills, R. Booker, Y. Lu, "Soft X-ray Continuum Radiation from Low-Energy Pinch Discharges of Hydrogen," IEEE Trans. Plasma Sci, submitted.

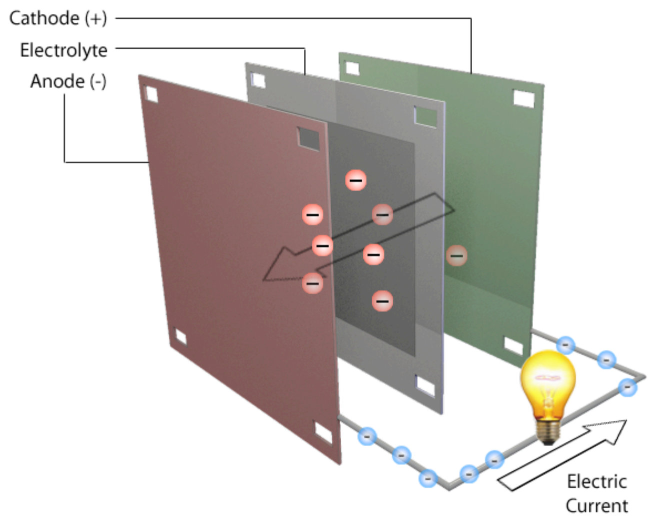
[3] R. L. Mills, Y. Lu, "Time-Resolved Hydrino Continuum Transitions with Cutoffs at 22.8 nm and 10.1 nm," Eur. Phys. J. D, 64, (2011), pp. 63, DOI: 10.1140/epjd/e2011-20246-5.

[4] R. L. Mills, Y. Lu, "Hydrino Continuum Transitions with Cutoffs at 22.8 nm and 10.1 nm," Int. J. Hydrogen Energy, 35 (2010), pp. 8446-8456, doi: 10.1016/j.ijhydene.2010.05.098.

[5] K. Akhtar, J. Scharer, R. L. Mills, "Substantial Doppler Broadening of Atomic Hydrogen Lines in DC and Capactively Coupled RF Plasmas," J. Physics D: Appl. Phys., Vol. 42, Issue 13 (2009), 135207 (12pp).

[6] R.L. Mills, K. Akhtar, "Tests of Features of Field-Acceleration Models for the Extraordinary Selective H Balmer α Broadening in Certain Hydrogen Mixed Plasmas," Int. J. Hydrogen Energy, Vol. 34, (2009), 6465–6477.

CIHT cell schematic:



On two separate visits to BLP's facilities in Cranbury NJ on November 30, 2011 and on December 15, 2011, I reviewed the classical theory and analytical data regarding the identification of the newly identified form of hydrogen as the cell product, the lower state hydrogen called "hydrino." I also reviewed the test results and report of Dr. Ramanujachary of Rowan University who had performed mass and electrical energy balances on 11 CIHT cells. Excess electrical energy, from roughly two to seven times that used for water electrolysis, was produced in cells run as long as thirty days. Exhaustive analytical analyses were performed on multiple cells including elemental analysis by ICPMS, and XRF, XRD, gravimetric analysis and mass balance measurements by weight. No known conventional energy mechanism could be identified that would support the net energy generation seen. Rather, the hydrino formation, as theorized by Dr. Mills, has been confirmed by proton NMR analysis of the cell following operation.

Other cells operated in BLP's laboratory for long duration were consistant with the Ramanujachary cells, showing output electrical energy multiple times the input to the cell. Some of those were validation cells under test by Sanmina-SCI scientists, another independent validation team. On November 30th, I visited BLP and observed the preparation of the cell components, electrolyte and electrodes, and the fabrication, test assembly, and testing of three

CIHT cells using different anodes (negative electrode materials). I returned to BLP on December 15th. At that time, the accumulated electrical energy gain from these cells were 207%, 547%, and 5476%, respectfully. These cells ran for a total of three weeks with stable performance, at which point they were shut down so that other experiments could be run.

Data from the test cells was captured on two separate, state-of-the-art and highly accurate Arbin Instruments battery and fuel cell test stations. Both were factory calibrated in March 2011 and were redundantly calibrated with a digital oscilloscope, standardized against NIST (National Institute of Standards and Technology) standards, confirming that the instrumentation accurately recorded accumulated electrical energy inputs and outputs. With unequivocal measurements of energy gain, well beyond any possible experimental error, a source of energy must be present besides that input for water electrolysis.

The experimental procedure had each cell placed in a sealed stainless steel, vacuum tight vessel with H_2O entrained in an inert (argon) carrier gas as the only mass input, or supplied with H_2O generated by a sealed H_2O vapor generator. No possible reaction exists amongst the electrodes or the electrolyte that could have produced the observed electrical energy. Furthermore, there is no possible reaction of H_2O with the cell constituents based on system thermodynamics. The only other possibility is that based on Dr. Mills' theory: H formed during electrolysis undergoes a reaction to form hydrinos with the release of electrical energy. Results were consistant with the proposed CIHT cell half-cell reactions forming the hydrino catalyst in the presence of atomic hydrogen, and the cell performance matched predictions based on the hydrino mechanism including the upfield NMR results characteristic of the hydrino product.

In summary, BLP has successfully fabricated and tested CIHT cells capable of producing net electrical output up to 50 times that input to maintain the process. Some cells have produced steady power for over one month. The power generation is consistant with Dr. Mills theory of energy release resulting from hydrino formation. No other source of energy could be identified.

BLP has achieved a historic success for a technology that could be directly commercialized as an alternative form of power generation. Potential applications range from stationary power infrastructure including the large-scale electrical grid to distributed and microdistributed scales and motive fuels infrastructure. The promise ultimately will be driven by economics.

The conceptual commercial CIHT design is similar in some ways to a molten carbonate fuel cell (MCFC). Both will run at elevated temperatures, though the CIHT requirement is not as high ~300 °C vs. ~600 °C for the MCFC. Also, the CIHT will not require a sophisticated fuel distribution design. The CIHT cell will use cheap, abundant, nontoxic, commodity chemicals, with no apparent long-term supply issues that might preclude commercial, high volume manufacturing. The cost of the chemicals based on optimization of the cell dimensions is estimated to be under $100/kW compared to ten times that for fuel cells that further require a source of hydrogen or hydrogen gas and a fuel infrastructure. The systems and operational parameters of the CIHT cell are expected to be simple compared to those of fuel cells such that the cost of chemicals should constitute most of the cell capital cost. Several other advantages of the CIHT include: 1) no toxic chemicals or discharge enabling operation open to the atmosphere, 2) the cells are stable with no self-discharge or other degradation, and 3) instantaneous power availability. The CIHT cell has clearly shown the capability to produce electricity. When properly scaled, such a system should be competitive across a wide variety of power markets including industrial, commercial, residential and transportation applications.

The next development target should be a 10 W, reproducible, demonstration system with output ratios similar to those observed in the initial laboratory tests. Based on current data and the success of the development of a bipolar plate, an essential milestone for scaling, this should be achievable near term. The Company should follow on with 100 W and 1000 W output CIHT systems, while simultaneously developing standard assembly techniques with power density optimization and miniaturization of the cell unit.

As BLP scales from 10 W to 1 kW, they will also want to begin conceptual design for a prototype commercial unit. An appropriate target would be a 1.5 kW system as that is a typical base load power for homes in developed countries. In addition to component optimization, BLP will need to develop appropriate electronic controls systems as well as the requisite interface to a local grid system. Initial focus on integration with the US grid system at 60 Hz is appropriate, with the European 50 Hz standard following. Development time will be saved in the long term if UL, CE, RoHS and other design standards are taken into consideration from the start.

Based on industry precedent, a team comprising nine scientists, engineers, and support personnel should be able to reach the 1 kW demonstration goal 12 to 15 months after the 10 W demonstration. Twelve months beyond that, BLP should be able to have a 1.5 kW prototype available for qualification. The Company may be able to exploit published industry knowledge and experience to expedite the development. The initial work is easily conducted in BLP's 53,000 sq ft facility with its present staff of scientists, engineers, and technicians including seven Ph.D.s. The Company should hire additional electrochemists, materials engineers, analytical chemists, inorganic chemists, system engineers, thermal engineers, and support staff as needed to meet the technology goals. In parallel, the Company may wish to pursue outsourcing development with battery and fuel cell companies such as Eagle Picher and United Technologies or contract R&D companies such as Fraunhofer Gesellschaft and Battelle. The estimated cost to the prototype demonstration unit is $15 - $20mm.

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