Validation of Excess Energy in the H_2 Loaded Palladium System

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Abstract:

The depletion of conventional energy resources necessitates the exploration of alternate energy sources, such as solar, wind, geothermal, and bio-gas. However, these renewable options havelimitations in different climatic conditions and require large land areas for installation, while their output efficiency remains comparatively low. To address this challenge, the study of Low Energy Nuclear Reactions (LENR) presents a promising avenue for green, clean, portable, and sustainable energy. The Centre for Energy Research (CER) at S-VYASA University, Bangalore, India, has actively pursued LENR research for the past 9 years.

Research groups have observed that the absorption of hydrogen into metal lattices is a crucial condition for LENR to occur. Various research groups, including CER, have explored metals like nickel, platinum, titanium, and palladium for high levels of hydrogen loading at controlled temperatures and pressures. In this study, two identical reactors were fabricated, one with an active fuel component and the other serving as a control unit. Both reactors underwent identical processes and hydrogen loading protocols. The active reactor consistently exhibited higher skin temperatures compared to the control reactor under the same power input, indicating the generation of excess heat. The experiment ran continuously for three months, showcasing sustained excess temperature.

Introduction:

The need to find alternate energy sources is very much a pressing demand on a global scale. Fossil fuel-derived sources are limited in availability and are not eco-friendly. On the other hand, renewable energy sources such as solar, wind, geothermal and bio-gas are having their limitations such as lower efficiencies, higher costs, unfavorable geography, competing with land usage and also being very much seasonal. Alternate energy sources can be a reliable source of options if one can demonstrate energy generation at lower costs, reliable operation and environmentally safe. One such source being experimented on and researched by scientists is using the concept of "Low Energy Nuclear Reaction or LENR". Energy generated using LENR can overcome most of the limitations faced by using other non-conventional energy sources [1].

LENR is a concept where Hydrogen (H2) atoms are made to undergo fusion at certain temperature and pressure conditions. The H2 gas is made to get absorbed into Palladium (Pd) treated Nickel (Ni)mesh under controlled pressure and temperature to trigger the reaction. Many countries are involved in researching LENR in different ways all around either Hydrogen or Deuterium gas atoms. A few countries viz, Russia, China, Japan and the USA are conducting extensive research to demonstrate theconcept and generation of excess heat energy using LENR. Centre for Energy Research (CER) at S-VYASA University, Bengaluru has been working on this concept from the past 7 years. The objectives were to successfully design and develop a stand-alone, sustainable, low-cost, clean source of portableenergy device. CER has conducted series of experiments demonstrating repeatable generation of excess heat without any radiation.

Efforts are now being made to develop the device as a commercial source of heat as it is capable of generating excess heat output for a given electrical input power. There is every possibility that, the output thermal energy can be converted into other forms of energy. Presently, this source can be usedas a room heater capable of heating rooms, halls, army bunkers over several months without any replenishment.

There are many alternative explanations proposed by scientists all around the world which could tryand describe the LENR working concept. Each research team has come up with their theory to describe LENR. However, there is no consensus on which of these is capable of explaining all the observations and justify quantum of excess heat. Research papers, conferences and journals on LENRmust be promoted in the mainstream media for the world to acknowledge the potential of LENR.

Equipment used

- Variable Frequency Supply : Aplab 8630P Input: 0-230V Single Phase AC. Output: 0-135/240V, 0-12/24 A, 45-450 Hz, single phase AC programmable supply
- Auto-transformer Dimmerstat : Input: 0-230 V Single Phase AC. Output: 0-230 V, 0-28 A,single phase AC
- Compact DAQ : National Instruments cDAQ 91744 Slot, USB Compact DAQ Chassis
- Pressure Transducer: Equinox EQ PT700A Measuring range: 0-1 bar (abs), Output: 4-20 mA,Process Conn: 1/4-inchBSP for Data Acquisition. Input 230 V AC. Output USB
- Direct Drive Rotary High Vacuum Pump INDVAC

Sample Preparation:

Before starting any experiment, the reactor chamber is cleaned thoroughly to remove any impurities. Nickel meshes are cut to the desired size, cleaned thoroughly & complete care was taken to remove oil, trapped gases and oxide layers if any. Initially mesh was cleaned with sand papers, thenwith mild detergent, and ethanol [3]. Further the mesh was heated to 300 °C and applied vacuum simultaneously. Removal of oxide layer was further confirmed with one of the samples with EDS analysis. The mesh was weighed soon after cleaning. Palladium is then deposited over the meshes as a thin layer (The process patent under review) and once it is done, the meshes were weighed again. Thedifference in weight of the meshes before and after Pd deposition determines the quantity of Pd deposited. Palladium deposition was done by RF sputtering over Nickel mesh and the Pd thickness is100 nm weighing 30 mg.

Pd-deposited meshes are positioned inside the reactor chamber. The ends of the reactor flanges are then closed and sealed air-tight. The reactor chamber is then degassed at elevated temperatures to remove moisture and any impurities (the pressure read with the display was 100 Pa, this might be theleast count of the display). The heating is then turned off and the reactor is cooled down to room temperature (RT).

After the reactor reaches room temperature, the vacuum pump is turned off and the reactor is flushedthoroughly with H2 gas. It is then filled with H2 gas at low vacuum levels (H2 is filled with just 30K Pa. The absorption of H_2 is done at Room temperature) [3,4]. Since Palladium-Nickel mesh has a very strong tendency to absorb hydrogen gas, we see the Hydrogen pressure falling. (Generally 1000 to 1500 Pa pressure drop will be there during H_2 absorption. What we have observed is that, if there is no H_2 absorption for unknown reasons, excess heat is not generated). The active experiment is started after completing the above procedures.

Experimental setup and procedure:


Figure 1: The reactor setup

The experimental setup used at CER has a stainless steel (SS) heating chamber where the active component to be heated is placed inside as shown in *Figure 1*. The reactor is a cylindrical hollow tube having a volume of 6.36×10^{-5} m^3. A cartridge heater is inserted into the reactor chamber for heating purposes. A vacuum pump is used to apply the vacuum to the reactor before sealing and a pressure transducer is used to monitor the reactor pressure.

The active materials used for the experiment are Nickel mesh deposited with Palladium. Acalculated quantity of Palladium is deposited over the Nickel mesh. H_2 gas under vacuum conditions is used for the experiment [6].

The reactor is electrically heated by using a sealed cartridge heater. A K-type thermocouple embedded in the heater is used to measure the temperature of the heater coil. A single-phase, variableAC power supply is used to heat the reactor to the desired temperature by varying the voltage applied and the input power is measured using a digital power meter. The current drawn by the reactor at different voltages is also measured using a current transformer.

The temperature readings at different power levels are recorded by placing various thermocouples at different regions of the reactor. The heater temperature (Core temperature) is measured by the embedded thermocouple in the heater. The reactor body temperature (surface) is also measured by embedding the thermocouple on the surface of the reactor using a high-temperature adhesive. All the experimental data are continuously monitored and recorded using a customized data acquisition system. This data is further utilized for analysis and interpretation.

In the calibration experiment, untreated Ni meshes are positioned in the reactor and H_2 gas is filled tothe same pressure as done in active experiment. The experimental setup and instrumentation are maintained identical as done in the active setup. Rest of the procedure is followed as done in the active experiment and the data is logged. In one of our experiments, we also employed the same reactor for both the active and calibration measurements, ensuring consistency in all parameters. Thisapproach was adopted to minimize potential variations that could arise from using different reactors.By using the same reactor, we aimed to isolate the effect of the active material and accurately assess its impact on surface temperature. The temperatures obtained in the calibration experiment are comparedwith the active experiment and plotted. The twin setup is shown in the Figure 2.

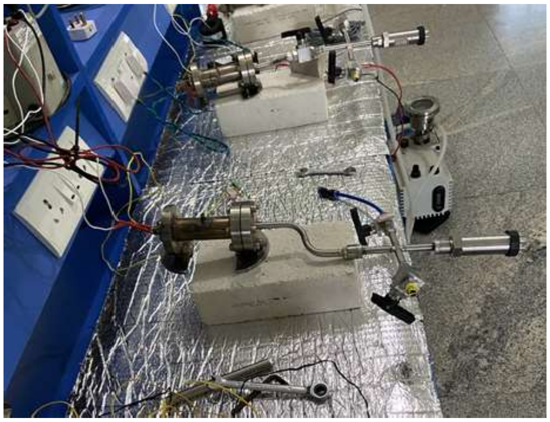
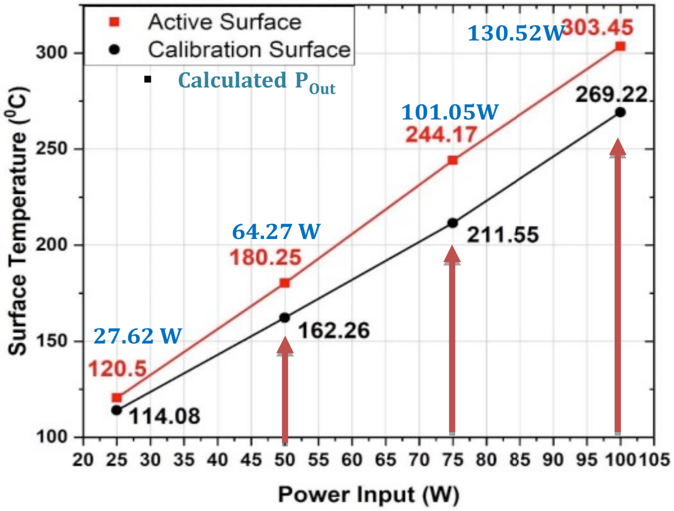


Figure 2: Parallel experiment setup

Results:

At CER, two identical reactors were run in parallel having the same configuration. One was used as active reactor and the other was used as a calibration reactor. The temperature of surface was used as an indicator for comparing the data of both the reactors. It was seen that the surface temperatures read in the active experiment was consistently higher (Graph 1) than the calibration experiment at all the power input values over several months on a 24x7 basis. The same is plotted continuously on 24X7 basis and is shownin ***Graph 2.*** The temperature readings were observed for more than 2 months and the active experiment showed higher temperature than calibration overentire duration.



Graph 1: Graph of Surface Temperature (C) Vs Power input (W). The calculated power output for the active experiments also mentioned in the graph (quantification done by comparing with the data of calibration experiment)

From the graph1, it is seen that for power inputs of 25 W, 50 W, 75 W and 100 W, the surface temperature was higher for active than in calibration reactor by 6.42°C,17.99°C, 32.62°C and 34.23°C respectively. The power output was calculated with the following equation and is mentioned in the graph for different power inputs.

$$Q = \epsilon\sigma A(T_h^4 - T_c^4)$$

Where Q = Total heat energy radiated in Watts

σ = Stefan Boltzmann constant, 5.670 x 10^{-8} W m^{-2} K^{-4}

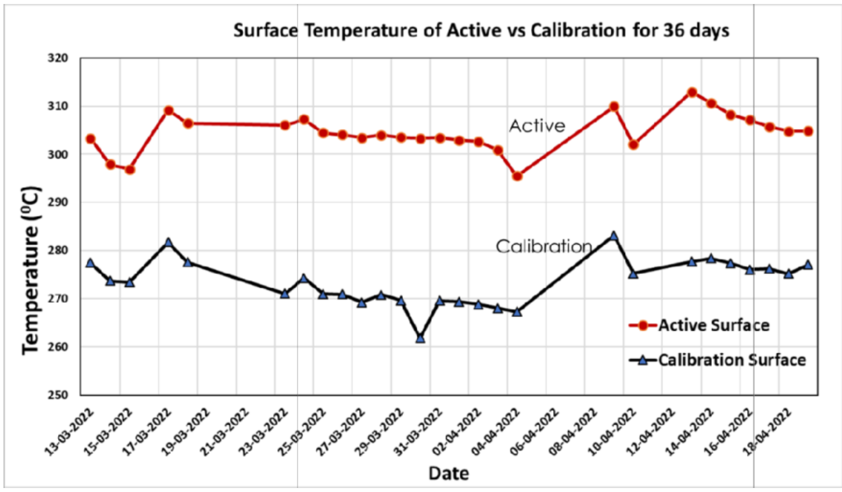
ε = emissivity of the reactor material

A = Total surface area of the reactor body in m^2

T_h = Surface temperature of the reactor in K (hot body)

T_c = Temperature of the surrounding air in K (cold body)

The surface temperatures for both active and calibration experiment are also plotted in ***Graph 2*** for aperiod of 36 days at constant power input of 100 W. It is seen that the surface temperature of active experiment temperature value was always higher than surface temperature of calibration over the entire duration.



Graph 2: Surface temperature (C) (both active & calibration experiments) Vs Time for 36 days

Observations and Inferences:

As seen by the results, the active experiments show higher surface temperatures than that of calibration. One of the probable theories to explain the observed phenomenon is possibility of forming Tritium or Helium along with the release of energy in the lattice of the Pd. Factors such as inter lattice crevices in the Pd, purity of the mesh and the gas play an important role in obtaining excess energy. CER is trying to simulate and develop a thermal and mathematical model of the working concept of the designed reactor. CER is constantly trying to improve the performance of thereactors by continued research and refining the experimental protocol.

Conclusion:

Based on the experimental data and the results obtained thus-far, CER has shown that

LENR is a topic of interest which should be pursued by other scientific communities around the world. The following conclusions can be drawn by CER based on the research work carried out:

- The excess heat seen in experiments is replicated in different experiments at CER, Bangalore and other cities.
- Multiple efforts are being tried at CER to improve the energy output of the reactor.
- The reactor can be used as a room heater with improved efficiency.
- Eventually the reactor with improved efficiency can be used as an energy source to generate electricity
- CER is working on the possible theoretical explanation which can describe the experimental results.

- The heat loss is not only through radiation. It is through radiation, conduction & convection. Some experiments have also been conducted in a closed small room, by maintaining the ambient temperature a constant. Still the device was capable of generating excess heat

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