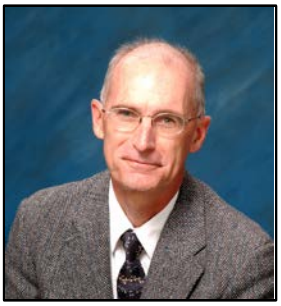
Generation of High-Temperature Samples and Calorimetric Measurement of Thermal Power for the Study of Ni/H_2 Exothermic Reactions



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Instrumentation developed to measure heat power from a high-temperature reactor for experimental trials lasting several weeks is being applied to gas-phase Ni/H_2 LENR. We developed a reactor that can maintain and record temperatures in excess of 1200^o C while monitoring pressures exceeding 7 bar. This reactor is inserted into a flowing-fluid calorimeter that allows both temperature rise and flow rate of the cooling fluid to be redundantly measured by different physical principles. A computerized data acquisition system was written to automate the collection of more than 20 physical parameters with simultaneous numerical and dual graphical displays comprising both a strip chart and complete history of key parameters.

The water inlet and outlet temperatures of the calorimeter are simultaneously measured with thermocouple, RTD, and thermistor sensors. The water flow is passed in series through two calorimeters and a Hall-effect flow meter. The first calorimeter houses a resistance heater of known input power, which allows the flow rate to be inferred from the heater power and water inlet and outlet temperature difference. Careful calibration of this system produces a nominal accuracy and precision of ±1 W.

The reactor is constructed by tightly wrapping Kanthal wire around an alumina tube, which is embedded in ceramic-fiber insulation (see Figures 1 and 2). The length of the alumina tube is chosen so that its unheated end remains below 100^o C when the interior volume of the heated end is 1300^o C. During use the internal reactor temperature is inferred from two type-N thermocouples fixed to the outside of the reactor using a previously made calibration that employed internal thermocouples. Using external thermocouples have advantages: the thermocouple metals cannot react with the reactants; the thermocouples are kept at lower temperatures (usually < 1000^{o}C) increasing the thermocouple's life and accuracy; no high pressure/vacuum feedthrough is required; no high temperature electrical insulation isolating the thermocouple from the reactants is necessary.

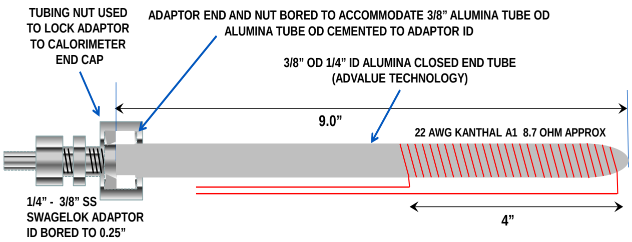

Figure 1. Reactor Design

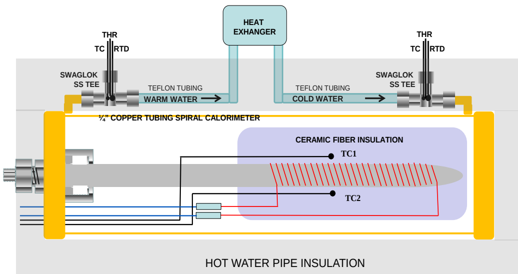

Figure 2. Reactor inside the calorimeter.

This instrumentation is being used to study the gas-phase anomalous heat effect (aka LENR) using nickel and light hydrogen. Tests are being undertaken using both $LiAlH_4$ and bottled H_2 as the source of hydrogen. The results from these tests will be presented with special emphasis on the morphology and the cleaning of the surface of the nickel particles, absorption of hydrogen by the nickel, and excess heat or lack thereof.

All techniques and data will be presented in sufficient detail to allow reproducibility. Nothing will be deemed proprietary. Source code and documentation of the data acquisition software resulting from a significant development effort will be distributed on request.