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Short communication

Comment on papers by K. Shanahan that propose to explain anomalous heat generated by cold fusion

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Abstract

Dr. Shanahan has published two papers (Thermochim. Acta 428 (2005) 207, Thermochim. Acta 382 (2002) 95) in which he argues that excess heat claimed to be produced by cold fusion is actually caused by errors in heat measurement. In particular, he proposes that unrecognized changes in the calibration constant are produced by changes in the locations where heat is being generated within the electrolytic cell over the duration of the measurement. Because these papers may lend unwarranted support to rejection of cold fusion claims, these erroneous arguments used by Shanahan need to be answered.

Keywords: Calorimetry; Error; Cold fusion

1. Discussion

Dr. Shanahan has published two papers, one [1] discussing the work of Szpak et al. [2] and the other [3] addressing the work of Storms [4]. In both papers, he argues that excess heat claimed to be produced by cold fusion is actually caused by errors in heat measurement.

Shanahan makes two basic assumptions: that significant heat can be produced at different locations within a cell because recombination between the evolving D_2 and O_2 gases can take place at different locations, and that a flow calorimeter is sensitive to where heat is being produced in the cell. Both these assumptions have been shown by experimental observation to be irrelevant to explaining anomalous heat in a Fleischmann–Pons electrolytic cell.

As anyone who has viewed a Fleischmann–Pons (F–P) electrolytic cell will testify, all D_2 is generated at the cathode and all O_2 is generated at the anode, with both gases rising rapidly to the surface as bubbles. Bubbles contain mainly only one of these gases. Consequently, significant heat from recombination cannot be produced, as Shanahan proposes, because very few bubbles reach the opposite electrode. Consequently, surface recombination on the electrode surface is small even if a few bubbles should collide and mix their contents. The recombination process has been explored by a number of people and summarized by Storms [5] in Fig. 1. The basic conclusion from this body of work is that recombination of the type Shanahan assumes is only apparent at low applied current, a condition during which very little recombination heat can be produced and at currents far less than those required to produce anomalous energy. For example, at 1 A, a typical current used in a Fleischmann–Pons cell, the total amount of power that can be produced by recombination is $1.54 \times 1 = 1.54$ W. As the data in Fig. 1 show, less than 5% of this power is recombined within the cell at the electrode surfaces. Consequently, $1.54 \times 0.05 = 0.077$ W is the maximum power that can change its production location in an open cell. Even at 0.01 A, the maximum heat generated at an electrode surface by recombination is $0.01 \times 1.54 \times 0.3 = 0.0046$ W. However, if an internal catalyst is present, as is the case during most modern studies, the remainder of the power from recombination is generated at this fixed location. At currents normally used to generate anomalous energy, this recombination power is much less than that generated at or near electrode surfaces by Joule processes, which can reach 20 W. In summary, the

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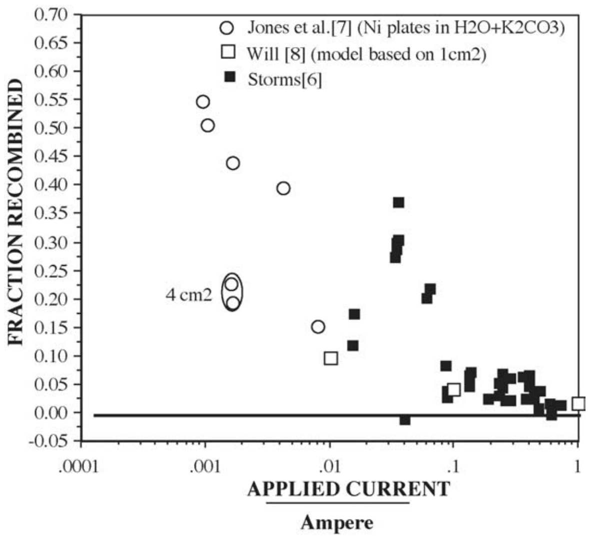

Fig. 1. Fraction of generated gas that is recombined on the electrodes as a function of applied current [7,8].

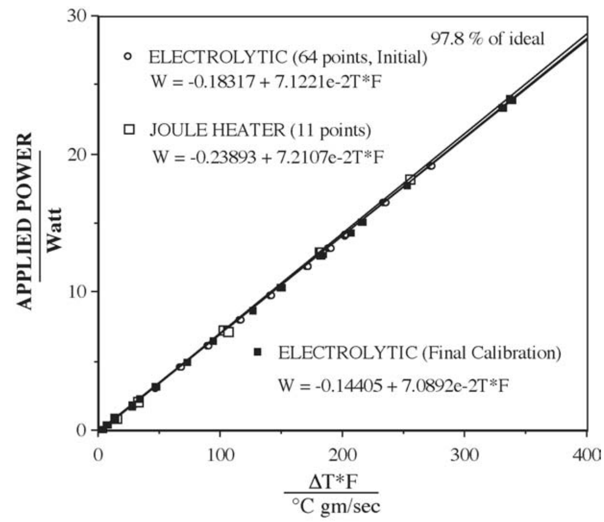

Fig. 2. Calibration equations for a flow-type calorimeter comparing heat production using electrolysis of a "dead" cathode and using an internal resistor.

amount of power that can change its location is very small compared to the total amount of power being generated in the cell.

Before discussing the sensitivity of the calibration constant to where heat production occurs, I would first like to provide a general background about calorimetry. More details can be found in "Calorimetry 101 for Cold Fusion" found at http://www.LENR-CANR.org/. Three types of calorimeters are normally used to measure heat production in cold fusion cells. The isoperibolic type measures temperature drop across a thermal barrier located between the electrolyte and a constant temperature bath. If the cell wall is used as a barrier, errors such as Shanahan proposes can result if the source of heat changes location. These errors are well known and were acknowledged in earlier studies. Most workers now use a flow calorimeter, which determines heat production based on the temperature change of water flowing through or around the cell. This design has been examined by the author [6] to determine the effect of heat location. For example, calibration using an internal resistor causes a large fraction of generated heat to be produced where the resistor is located. Because no electrolysis occurs, no heat is produced at the electrodes or at the recombiner. The amount of power involved in this change in location can be as high as 27 W, compared to the maximum produced by the Shanahan effect of <0.2 W. Nevertheless, electric power applied to a resistor gives nearly the same calibration constant as when energy is applied to a dead cathode (see Fig. 2). In other words, when a large change in where a large amount of heat is generated within the cell is made on purpose, little or no effect on the calibration constant is observed. In contrast, Shanahan proposes that a change in the location of a small amount of heat production can cause a calibration change, which has been attributed to the cold fusion effect. This proposal is made in spite of the behavior described above being well known and without acknowledging why these measurements do not apply.

Shanahan [1] makes additional assumptions about a paper by Storms [4]. He rejects the claim for excess energy because an occasional offset error in calibration constant of 2.5% would explain the claimed excess. On the other hand, a random variation of only 1.6%, based on many measurements done over three months, was found. He has not explained why the calibration constant would suddenly make such a change exactly when applied current was changed to initiated excess power and do this four times while failing to change at other times during the study or fail to occur during calibration. No such nonrandom error was ever observed when the cell was calibrated nor when it was run using a clean platinum cathode.

2. Conclusion

The assumptions used by Shanahan to explain anomalous heat claimed to result from cold fusion are shown to be inconsistent with experimental observation.

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