

Experiments Supporting the Transmission Resonance Model for Cold Fusion in Light Water: I. Correlation of Isotopic and Elemental Evidence with Excess Heat

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ABSTRACT

The experimental evidence cited here (Part I) in support of the Bush TRM Model was originally reported by Bush² in his paper, "A Light Water Excess Heat Reaction Suggests That 'Cold Fusion' May Be 'Alkali-Hydrogen Fusion.'" Excess heat production in electrolytic light water experiments was experimentally correlated with a shift not only in elemental abundance but also with an isotopic reversal in the case of a light water-based Rb_2CO_3 cell found to produce strontium. Part II³ reports on more recent work correlating x-ray emissions with excess power for both a heavy water excess heat reaction and a light water excess heat reaction.

1. Introduction

Bush's three dimensional transmission resonance model (TRM)² predicts a unique variation in the excess power for an electrolytic cold fusion cell as a function of the applied current density and cell temperature. Previous experiments⁴ involving heavy water yielded data in agreement with the predictions of this model^{1,2}. The present paper cites more recent work with alkali ions in light water originally reported by Bush.² In that paper he hypothesized that the light water excess heat reaction with potassium carbonate originally reported by Mills and Kneizys⁶ and the heavy water excess heat reaction of Fleischmann and Pons⁵ are two sides of the same coin, the latter representing low energy nuclear processes at, or within, a metal lattice. These processes were hypothesized to involve the transfer of either a proton, deuteron, or triton, to an alkali nucleus, yielding three forms of "alkali-hydrogen fusion", respectively, as the prototype for a generalized low energy nuclear transmutation in a lattice². ("Alkali nucleus" was taken to include hydrogen itself.) This form of fusion avoids two thorny problems inevitably cited by critics of "cold fusion;" viz. a spectacular insufficiency of neutrons, and of gamma rays. (X-ray emission, which would be

expected in connection with the product nucleus is correlated with excess heat production in Part II.) Bush² hypothesized calcium and strontium, respectively, as the nuclear products in the cases of the light water excess heat effect employing alkali salts of potassium and rubidium, such as the carbonate or hydroxide. Excess heat production was correlated² with an elemental shift from potassium to calcium in support of the Bush TRM Model^{1,2}. Here we give more details of the work reported by Bush² involving the elemental shift from rubidium to strontium and the isotopic reversal between Sr86 and Sr88 hypothesized and measured in the case of a light water-based rubidium carbonate cell.

2. Apparatus

The electrolytic cell employed is similar to that Fleischmann-Pons⁵ with the following principal modifications: (a) the use of a *platinum black recombiner* in the cell to allow for *closed-cell operation*, (b) a *magnetic stirrer* that provides for more uniform electrolyte mixing, and (c) *Teflon* coating of all nonelectrode materials to reduce electrolyte contamination. It consists of a double wall pyrex vessel surrounded by a one inch thick layer of styrofoam. Cell temperature is regulated by controlling the temperature of the bath water which flows through the jacket surrounding the cell. Cell temperatures, current, and voltage data were monitored and logged using a Macintosh Ix computer equipped with National Instrument's LabView software. Four type K thermocouples were used with each cell: one at the bath inlet port, one at the bath outlet port, and two within the electrolytic cell. The thermocouple voltages were converted to temperature by use of AD595AQ/9217 integrated circuit chips. This system permitted steady state temperature measurements with standard deviations of about 0.05 °C. Corrections for thermocouple temperature offsets were made within the software. The cells' current and voltage signals were logged from Fluke 45 dual display multimeters which were equipped with an IEEE bus. In the case of the light water cells the nickel sponge (nickel fibrex) cathode typically forms an open cylinder of thickness 0.5mm and radius about 1.5 cm, with a platinum wire positioned axially as the anode. Calibration is achieved by running the cell anodically, and can typically be checked on the fly.

3. Rubidium Carbonate Cell: Elemental and Isotopic Analysis and Correlation With Excess Heat.

Figures 1-4 on the last page show a mass spectrogram resulting from a SIMS analysis of the cathode of cell 53: [light water based 0.57M Rb₂CO₃ electrolyte (50 ml), platinum wire anode (18 cm long, 1mm diam.); sponge nickel (fibrex) cathode (45 cm² "area"); charging began 9:20PM, (2/1/92) (1 mA/cm²); excess heat detected: (2/4/92); cell turned off: (3/25/92); peak excess power: 4.3W (Input: 6.34V/2.36A/14.96W, gain 28.7%), average excess power: (1.81 ± 0.37) W; total excess heat: (6.4 ± 1.3) MJ.] Fig. 1 shows the post-run, (0-100) amu ("atomic mass units") mass spectrum (spectrogram) with large signals for Rb85 and Rb86 and significant signals at mass numbers 86 and 88, which Bush² interpreted to correspond to strontium; viz. Sr86 and Sr88, respectively. {Note that the signal "bias" has been turned way up in going from the spectrum of Fig. 2: [(pre-run), (0-100)amu] in order to accommodate the large rubidium signals and to suppress noise. This can be gauged

by noting that the nickel signal (Ni) has been significantly reduced in going from Fig. 2 to Fig.1. In addition, the signals in Fig.2 between masses 66 and 100 that appeared in Fig.2 have, for the most part, been suppressed in Fig.1. The NiO signal at mass 74 was large enough in Fig.2 to still show up in Fig.1, but the original signals for mass numbers 86 and 88 in Fig.2 are clearly too small with the bias employed for the spectrum portrayed in Fig. 1 to contribute noticeably to the signals at 86 and 88 of the post-run spectrum. [The niobium (Nb) appearing in Fig. 1 was apparently the result of having employed the platinum anode of cell 53 in a previous cell, number 48, which had a reference electrode constructed from a platinum-coated niobium wire.] Now, the most striking feature of the post-run spectrum, as reported by Bush², is that the ratio of the strontium signals (86-to-88) is close to that of the rubidium signals (85-to-87), or about 2.59. Had the strontium been the result of contamination, one would expect to see the ratio of the strontium signals mirroring the normal abundance ratio for these isotopes; viz. about 0.12.

[It should be noted that, while the electrolyte was not analyzed for strontium, an analysis of the pre- and post-run for cell 49, a previous Rb₂CO₃ cell at Los Alamos (LANL) via arc spectroscopy showed no elemental strontium in either the post- or pre-run electrolyte samples from cell 49 down to a concentration of 50 ppb. (An earlier positive test of the electrolyte of cell 49 for strontium by Geo-Monitor, Inc.¹ was probably flawed by the assumption that a linear extrapolation could be made in the case of a flame photometry device set with the "zero" not corresponding to 0 ppm for strontium.) In addition, a mass spectrometric study of similar electrolyte samples from cell 49 by West Coast Analytical Service, Inc of Santa Fe Springs, CA, showed no strontium isotopes down to a concentration of 5ppb. (The 5ppm reported in Bush's paper was an uncorrected typing error.) The anode was not analyzed for strontium. However, here, as in the case of the electrolyte, strontium in the post-run cathode resulting from contamination would have isotopically mirrored the natural abundance ratio rather than showing an isotopic reversal.] In his report, the SIMS operator specified the ratio of the post-run "strontium" signal to that for rubidium as 6.2×10^{-5} . Based upon the known rubidium concentration of the electrolyte and the excess heat measured for cell 53, Bush has recalculated a theoretical value for this ratio of $(7.4 \pm 1.5) \times 10^{-5}$, in good agreement with the above experimental value, and in support of his "alkali-hydrogen fusion" hypothesis². (This replaces an earlier estimate of Bush² based upon an incomplete assessment of the excess heat for cell 53.) It is interesting to note that the SIMS operator reported the strontium as "rubidium hydride". However, although his mass spectroscope was incapable of distinguishing strontium from rubidium hydride, the latter is very unstable and known to dissociate at 27 C. As a measure of how patently absurd the hypothesis of rubidium hydride is, our contact at the national laboratory, who arranged the out-of-house SIMS test, points out that the signal in the mass spectrum for the much more stable rubidium oxide in Fig. 3 is lower than the signal for the so-called "rubidium hydride" of Fig.1. (It is sad to have to report that the highly competent SIMS operator was apparently sufficiently upset that he was analyzing the results of a "cold fusion" experiment that this, no doubt, influenced his choice of labelling for the masses 86 and 88 in the post-run spectrum of his report. In addition, because of the negativity surrounding cold fusion, both our helpful contact of noted expertise and integrity and his otherwise fine, and certainly prestigious, laboratory must remain anonymous for the

present time.) Thus, it is apparent that the signals at masses 86 and 88 of Fig. 1 more than likely represent strontium, in spectacular corroboration of the hypothesis of "alkali-hydrogen fusion"² in a metal lattice.

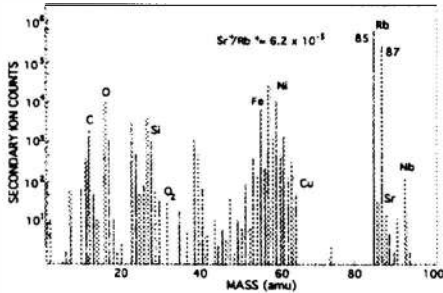


Figure 1. Cathode post-run mass spectrogram.

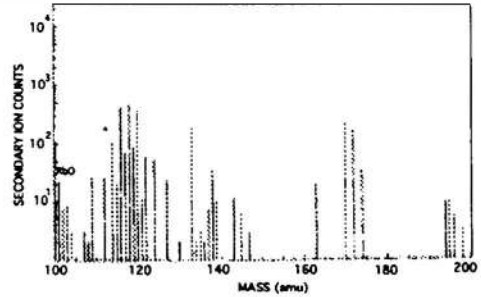


Figure 3. Cathode post-run mass spectrogram.

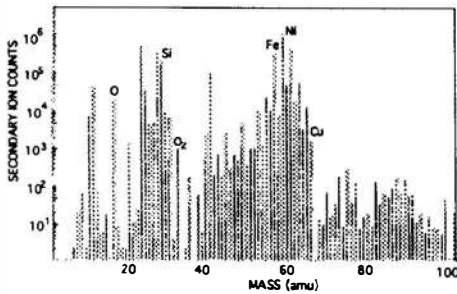


Figure 2. Cathode pre-run mass spectrogram.

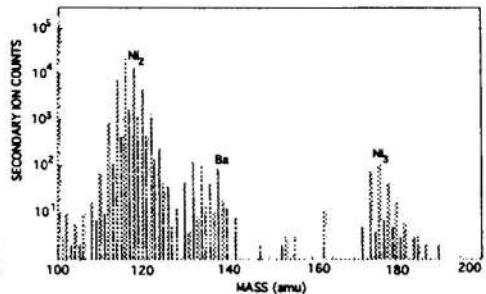


Figure 4. Cathode pre-run mass spectrogram.

Acknowledgments: These are listed once after Part II.³

References:

1. R. Bush, "Cold Fusion": The Transmission Resonance Model Fits Data on Excess Heat, Predicts Optimal Trigger Points, and Suggests Nuclear Reaction Scenarios," *Fusion Technol.*, 19, 313 (1991)
2. R. Bush, "A Light Water Excess Heat Reaction Suggests That 'Cold Fusion' May Be 'Alkali-Hydrogen Fusion'", *Fusion Technol.*, 22, 301 (1992)
3. R. Bush and R. Eagleton, "Experiments Supporting the Transmission Resonance Model for Cold Fusion in Light Water. II. Correlation of X-Ray Emission With Excess Power", *Proceedings of the Third Annual Conference on Cold Fusion*, Nagoya, Japan, Oct. 21-25, 1992.
4. R. Eagleton and R. Bush, "Calorimetric Evidence Supporting the Transmission Resonance Model for Cold Fusion", *Fusion Technol.*, 20, 239 (1991).
5. M. Fleischmann and S. Pons, "Electrochemically Induced Nuclear Fusion of Deuterium," *J. Electroanal. Chem.*, 261, 301 (1989)
6. R. Mills and K. Kneizys, "Excess Heat Production by the Electrolysis of an Aqueous Potassium Carbonate Electrolyte and the Implications for Cold Fusion," *Fusion Technol.*, 20, 65 (1991).