

COLD FUSION BY ELECTROLYSIS IN A LIGHT WATER-POTASSIUM CARBONATE SOLUTION WITH A NICKEL ELECTRODE

COLD FUSION

TECHNICAL NOTE

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REIKO NOTOYA *Hokkaido University, Catalysis Research Center
Kita-11, Nishi-10, Kitaku, Sapporo, 060, Japan*

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The evolution of a large amount of heat, unexplainable by ordinary chemical reactions, was observed in an electrolytic cell with a nickel cathode and a platinum anode in a potassium carbonate-light water solution. The nickel cathode had a specially designed porous structure, based on fundamental knowledge concerning the active hydrogen electrode in alkaline solutions. An increase in the concentration of calcium ions was observed in the electrolyte, which seems to be the result of potassium-hydrogen cold fusion.

I. INTRODUCTION

Since cold fusion by the electrolysis of heavy water was proposed by Fleischmann and Pons,¹ many attempts have been made to confirm their results. Recently, the production of excess heat by the electrolysis of a light water-potassium carbonate solution with a nickel electrode was presented by Mills and Kneizys² and also by Noninski.³ Bush⁴ at first considered the excess heat production observed in light water as "alkali-hydrogen fusion."

It was found that an intermetallic compound of alkali metal and electrode material, such as the intermediate sodium of the hydrogen evolution reaction, accumulated inside the nickel-solution interface during the electrolysis of an alkaline solution, and intermediate hydrogen was produced by the elementary step of the alkali metal intermediate and a water molecule.⁵ The accumulation of this intermetallic compound in nickel might accelerate the nuclear interactions between both hydrogen and sodium intermediates in the vicinity. The aim of this study was to obtain unequivocal evidence of this nuclear reaction. Considerable excess heat evolved at a nickel cathode during electrolysis in a light water-potassium carbonate solution. The amount of energy output was three times greater than the input power.

II. EXPERIMENTAL

The electrolytic cell used for the experiment was made of Pyrex glass and equipped with three electrodes: a 1.0- ×

0.5- × 0.1-cm test electrode of sintered nickel sheet (density = 5.9), a platinum counterelectrode, and a platinum reference electrode. Twenty millilitres of a light water solution of potassium carbonate with a concentration of 0.5 mol/l was used as the electrolyte, and it was stirred by bubbling hydrogen gas, at a gas stream rate of 1.5 ml/min, during the electrolysis. The nickel electrode was cathodically polarized galvanostatically at a constant current of 0.01 to 0.55 A, regulated with an accuracy of $\pm 10^{-4}$ A, and the temperature of the electrolyte was measured with an accuracy of $\pm 0.01^\circ\text{C}$. A standard Nichrome wire heater with a resistance value of 14 Ω was placed in the cell for comparison. The electrolysis was carried out simultaneously in twin cells, cell a and cell b, to confirm that the temperature of the electrolyte in each cell was not influenced by the temperature distribution in the thermostat chamber. The twin cells were placed in the center of the thermostat chamber, where the temperature was held at $19.39 \pm 0.01^\circ\text{C}$ by airflow circulated by sirocco fans during the electrolysis.

III. RESULTS AND DISCUSSION

Figure 1 shows typical time curves of the potential difference E between the cathode and the anode, the current I , and the temperatures T of the electrolyte in cell a and in the thermostat chamber. Figure 2 represents a typical relation between the input power given by electrolysis and the increase of electrolyte temperature. The input power is given by the following equation:

$$W_{input} = I(E - 1.482V), \quad (1)$$

where I and E denote the current and the potential difference between the test electrode and the counterelectrode, respectively, and 1.482V is the value due to the enthalpy change for $\text{H}_2\text{O} \rightarrow \text{H}_2 + (\frac{1}{2})\text{O}_2$ (Ref. 2). The potential difference at steady state was measured within an accuracy of 0.2% throughout the entire range of the constant current.

Figure 2 shows the increase of the electrolyte temperature for a standard resistor and for cells a and b. The electrolyte temperature increased by up to 50°C from the initial temperature of 20°C with an input power of 2.2 W, and the temperature rise was proportional to the input power in the 20 to 50°C temperature range. Figure 2 shows a linear relationship between the temperature increase and the input power

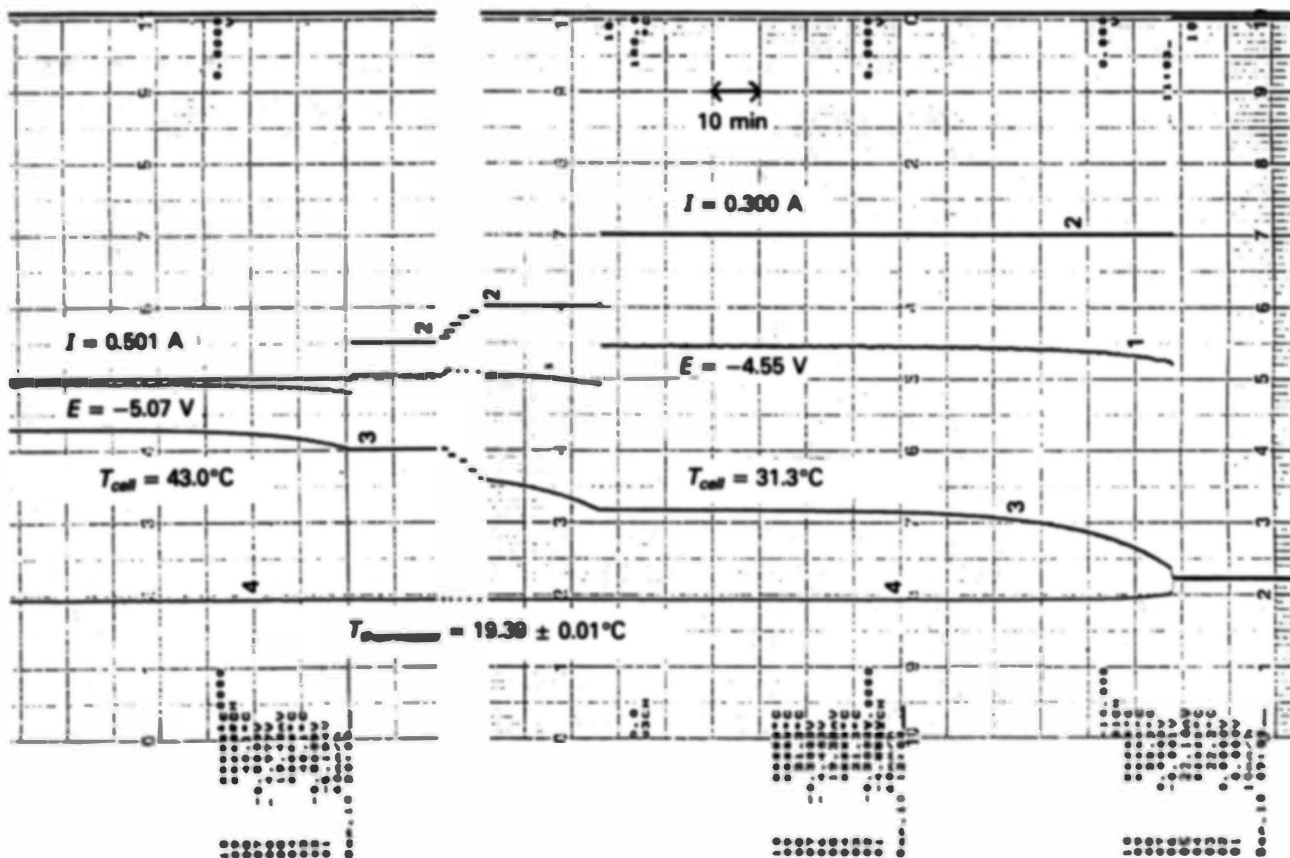


Fig. 1. Changes in (1) potential difference E , (2) current I , and electrolyte temperature T (3) in cell a and (4) in the thermostat chamber over time during electrolysis.

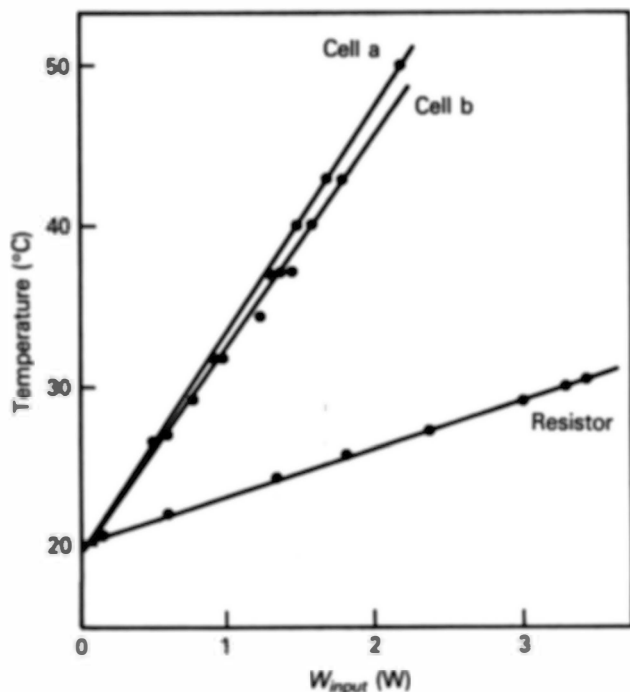


Fig. 2. Relationship between temperature increase in the electrolyte and the input power W_{input} in cells a and b as compared with a standard resistor.

with a correlation coefficient of >0.999 for both lines. The slopes of the lines for cells a and b are remarkably steeper than that for the standard resistor.

The difference in the value of input energy between the two lines at a given temperature in Fig. 2 can be defined as the excess heat. Figure 3 shows the relationship between the excess heat and the input power observed in the two cells. The excess heat was three times greater than the input power.

During electrolysis at current $I = 0.70$ A, flow rate of hydrogen stirring gas = 1.6 ± 0.1 ml/min, and electrolyte temperature $T = 54^\circ\text{C}$, the flow rate of the gas coming from the cell at the gas outlet was 10.0 ml/min, which roughly agrees with the total flow rate of the evolving hydrogen and oxygen gases estimated from $I = 0.70$ A (8.2 ml/min) plus the hydrogen stirring gas. Through all the excess heat measurements, the pH of the electrolytes did not change without any control of the content of the electrolyte. During 17 days of electrolysis, when a total quantity of electrons equal to be 33 820 C was spent by the current, the volume of the electrolyte decreased by ~ 3 ml. Therefore, the decrease of the electrolyte water due to vaporization was negligibly small.

After the electrolysis, the electrolytes were analyzed by flame photospectrometry (Shimazu AA-630) with an accuracy of 0.02 ppm. The calibration line of the intensity of the spectrum for calcium plotted against calcium concentration is shown in Fig. 4. By the use of this line, the concentration of calcium in the electrolytes after electrolysis was determined. The potassium carbonate solution used in determining the

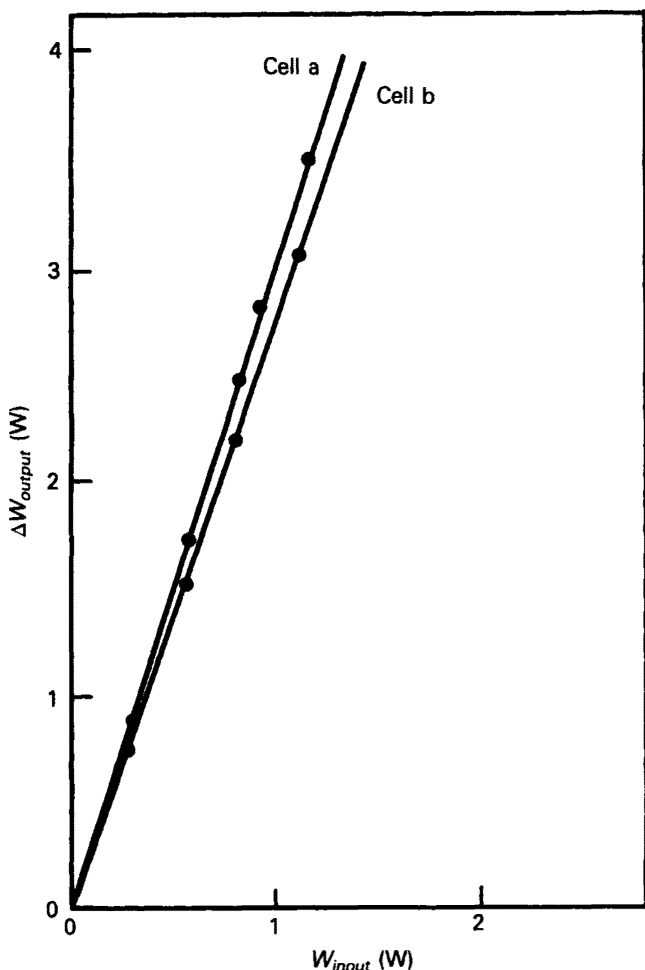
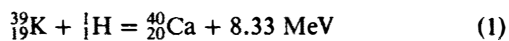


Fig. 3. Amount of excess heat ΔW_{output} evolved during the electrolysis with input power W_{input} in 0.5 M K_2CO_3 in cells a and b.

background values was subjected to all the same conditions except electrolysis during the experimental observation of the excess heat, and the background values were found to be 21 or 22 parts per million by weight (wppm). The increase of calcium concentration in the electrolytes due to electrolysis was 4.4 or 3.6 wppm. This amount of calcium is comparable with that of the excess heat calculated within the same order of magnitude.

Bush⁴ proposed the following nuclear reactions between potassium and a proton:



and

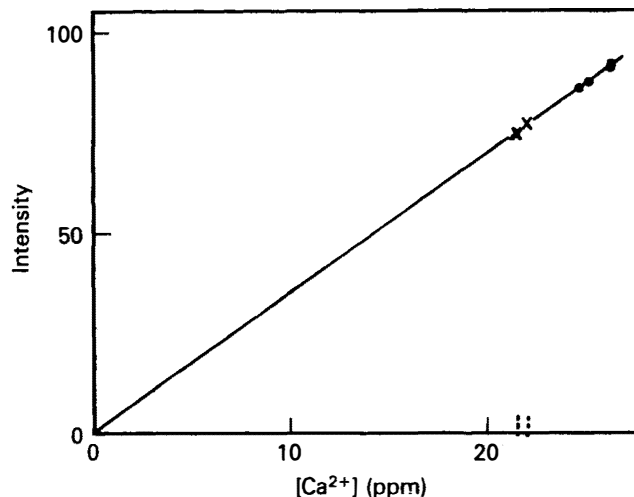
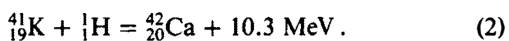


Fig. 4. Intensities of flame photospectra of calcium with concentrations of calcium ions in the electrolytes after electrolysis (●) and in electrolytes put into a cell without electrolysis (x). The solid line is the calibration line for the calcium ion concentration.

In this work, it was not clear which reaction, (1) or (2), was predominant in this system. To verify this, further study is being conducted.

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