Potential Error Sources in Combined Electrochemistry/Neutron Detection Experiments

A. Rieker*, B. Speiser, K.-M. Mangold, and M. Hanack

Institut für Organische Chemie, Universität Tübingen, Auf der Morgenstelle 18, D-7400 Tübingen 1, FRG

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Electrochemistry, Neutron Detection Experiments

Recently, experimental evidence for the occurrence of electrochemically induced ("cold") nuclear fusion of deuterium nuclei has been proposed by several groups [1–3]. In particular, increased neutron counts and excess heat production of the electrolytic cell have been reported. Although much debated, the results have neither been proven nor refuted unequivocally [4].

We have electrolyzed a solution of 0.1 M LiOD in D_2O in a U-shaped cell (see. Fig. 1) between a Pt anode and a Pd cathode (Degussa; surface area $\approx 2.7\ cm^2$). The evolved gases were collected separately to avoid the reformation of D_2O by surface catalysis on the noble metal electrodes. A constant current of 100 and 400 mA was lead through the cell by means of an AMEL Model 552. The cathode part of the cell was placed between two scintillation counters arranged at a right angle. The output of the photomultipliers was sorted by pulse shape discrimination analysis [5] into neutron and gamma events and the impulses counted separately. The electrolysis was conducted for 1000 s, while the events in the counters were followed. Then, the current was interrupted, the cell was moved away 5 m from the counters and the background was observed for 1000 s. This experimental cycle was repeated for 75 h.

The average numbers of neutron and gamma counts in the electrolysis and background periods, respectively, were compared. A small increase of the neutron events during electrolysis was found (+2.7% as referred to the background; the standard deviation for all background neutron measurements was 2%). However, at the same time the gamma counts decreased. This result may be attributed to a shift in the photomultiplier amplification causing the pulse shape discrimination electronics falsely to indicate neutrons while gamma events are occurring. A similar effect could be observed, when the electrolysis cell was replaced by a resistor and a constant current was passed through this dummy cell. The response of photomultiplier devices to exterior magnetic and electrostatic fields is well known [6].

Although we did not attempt to exactly control the heat production of the electrolysis cell, we observed a considerable temperature increase of the electrolyte during the experiment. At the same time the cell voltage U to maintain a constant current increased, indicating a considerable increase of cell resistance during the electrolysis. This effect

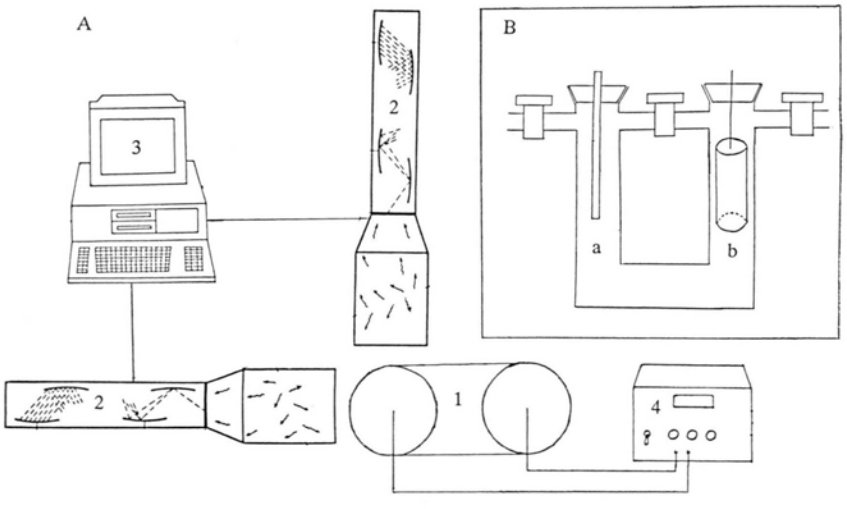

Fig. 1. Schematic set-up of the electrochemistry/neutron detection experiment. A: arrangement of electrochemical cell (1; top view) and neutron counters (2) with data collection and interpretation electronics (3) and galvanostat (4); B: side view of the electrochemical cell with a) Pd cathode and b) Pt anode.

* Reprint requests to Prof. Dr. A. Rieker.

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was avoided, when the anode compartment was purged with nitrogen during the background measurements. The evolved oxygen was blown out of the solution and the cell cooled to room temperature in this part of the experiment. Attempts to compare the heat production of a "cold fusion" electrolysis cell to the Joule heat have been made under the assumption that the supply voltage to the cell was constant [1]. If U increases, the heat generated by passage of current through the resistive electrolyte increases as well.

Although these experiments do not conclusively prove or dismiss the hypothesis of electrochemically induced nuclear fusion, we would like to point out that experiments and interpretations are prone to serious errors whose sources may not be obvious at first sight. We believe that the observations reported here may offer an explanation for the irreproducibility observed in many laboratories all over the world attempting to duplicate the original experimental work.

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