J. Condensed Matter Nucl. Sci. 14 (2014) 76–78

Research Article

Cathode to Electrolyte Transfer of Energy Generated in the Fleischmann–Pons Experiment

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Abstract

In our recent paper [1] we asked: why an exothermic system with the positive feedback, such as the Fleischmann–Pons experiment, does not suffer thermal run-a-way. In seeking an answer we selected two items (i) formation of hot spots and (ii) system's response following a fast nuclear event, that seem to point to a simple model of cathode to electrolyte energy transfer.

Keywords: Cold fusion, Electrolysis, Hot spots

1. Development of the Model

Reactions and processes associated with the selected items are discussed in [1]. Here, a brief description of relevant conclusions derived from (a) hot spots and (b) system' response forms the basis for the proposed model of heat transfer path.

2. Cathode to Solution Heat Transfer Path

Prior to the mini-explosion the system is in its pre-nuclear active state. A large number of deuterons and electrons is contained within a volume having radius of a few hundreds Angstroms, symbolically illustrated in Fig. 1 c1. At a certain time the fast nuclear reaction, resembling a mini-explosion, occurs, point A, causing local lattice destruction followed by forcing the hot reaction products into the solution, Fig. 1 c_2.

3. Comments

Experience shows that the polarized Pd/D–D_2O system typically maintains a temperature difference of a few degrees C above the solution. This is unexpected behavior for a positive feedback system unless (i) the heat is generated at

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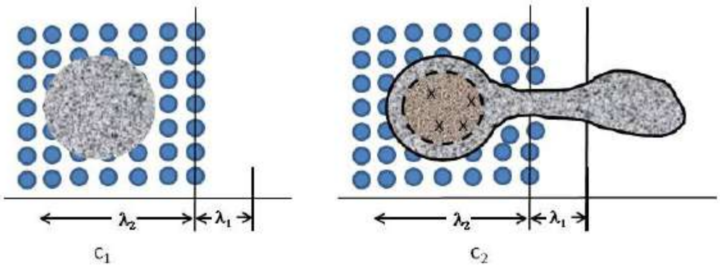

Figure 1. .

surface or (ii) very close to the surface and hot reaction products can penetrate the interphase. There is no evidence for (i) and limited information for (ii).

A domain, containing large number of reactants (deuterons and electrons), in its pre-nuclear active state is shown symbolically in Fig. 1 c_1 where it undergoes fast nuclear reaction (reaction time: a few nanoseconds). One possible explanation is that the reactions produce a very fast increase in pressure (e.g. a mini explosion) that "opens up" a pathway for the reaction product (probably helium) to escape before substantial damage of the lattice occurs due to the heat of reaction. The explosive event causes (i) an increase in volume, (ii) lattice expansion/destruction at the interphase and (iii) transfer of hot reaction products to the solution phase, Fig. 1 c_2. That it is to say that practically all energy generated is transferred to the solution. The heat stored at periphery of the expanded reaction volume is insignificant.

The system returns to its normal state within a fraction of a second ($\Delta t = 0.6$ s, Figs. 1 and 2 (b_1 and C_2). The endothermic heat of deuteriun absorption off-sets the residual heat stored in the periphery so that the cathode temperature remains constant.

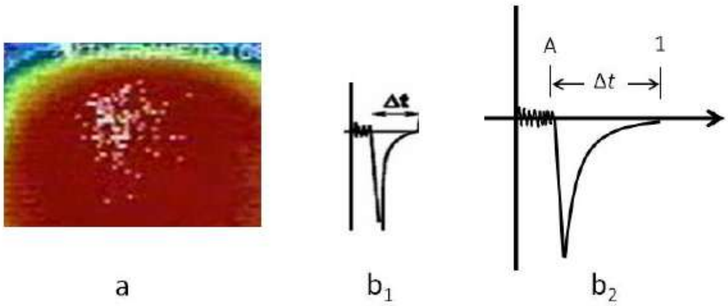

Figure 2. **(a)** The infra-red imaging of the cathode, prepared by co-deposition, of an operating cell reveals the presence of randomly distributed in time and space hot spots. These discrete heat sources are located in the close proximity to the contact surface, Fig. a. Information derived from hot spots is as follows: (i) formation of domains having the volume corresponding to the radius of a few hundred Angstroms, in which 10^9 fast reactions occur [2], (ii) the energy released is on the order of 0.1 kJ/g and must have been occurred on at time scale of less than 10 ns [3]. **(b)** System's response to the nuclear reaction recorded by a piezo-electric sensor, b_1 is that due to explosion. An extended view, Fig. b_2, shows: point 1 - system at rest. Point A - explosion, time period Δt system relaxes to its initial state. .

References

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