

The Extended Micro Hot Fusion Scenario

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The cold fusion neutron emissions, neutron bursts, and heat bursts can be explained by the extended micro hot fusion scenario. I describe the model and present the experimental evidence.

During the years 1986 and 1989 three experimental teams independently reported to have discovered cold fusion. The experiments differed strongly from one another, both in the applied methods and the reported results. Hence, the observational results need not necessarily result from one unique physical mechanism. Let us take a brief look at these three types of cold fusion.

Type 1: Mechanically treated LiD and heavy ice samples were reported to have emitted neutron bursts which have lasted for roughly ten minutes [1, 2].

Type 2: Motivated by geophysical observations (anomalous isotope ratios [3, 4]), electrolysis of deuterided metal was performed and reported to have generated low levels of neutrons of 2.5 MeV energy [3]. These emissions appeared a few hours after the start of electrolysis and terminated several hours later [3].

Type 3: Electrolysis of deuterided metals was reported to have emitted high levels of heat appearing days after the start of electrolysis [5-7]. Signals of nuclear fusion (neutrons, gamma rays) were at least 10 orders of magnitude too small to explain the reported heat emissions [5-7].

The experiments of type 1 were motivated by positive results of fracto-emission experiments and explained by the fracto-fusion model [1, 2]. An analogous "micro hot fusion" scenario was suggested [8] for the explanation of the type 2 experiments.

The micro hot fusion scenario can be described as follows [9, 10].

When hydrogen is absorbed by metals, then it forms bubbles around impurities and lattice defects of the metal. During their growth until a diameter of several micrometers, the bubbles deform the metal lattice and create mechanical stresses. After several hours, the mechanical stresses have become strong enough to create cracks which propagate through the metal lattice. The cracks are formed preferentially between the hydride bubbles and the weaker hydrided metal. Palladium dihydride is a semi-metal. Therefore the different electronegativities of metal and hydrogen generate positively electrically charged hydride bubble surfaces. Hence, the crack sides become electrically charged. Within the cracks of typically one micrometer width and ten to hundred micrometers length there arises an electric field strength of one hundred million volts per centimeter. Within strongly hydrided metals, electrons are bound stronger than hydrogen nuclei. Therefore the electric field within the cracks allows the hydrogen nuclei of the bubbles to accelerate until they reach energies of typically ten kilo-electron-volts.

Within the weaker hydrided metal, the hydrogen nuclei transfer their kinetic energy of several kilo-electron-volts to the metal lattice during a path of one tenth of a micrometer. This energy

transfer creates hot spots within the hydrided metal with a mean temperature of typically ten thousand degrees Celsius and a pressure of ten billion Pascal. Within the hot spots, the hydrided metal is gaseous. Because of the high internal pressure, the hot spots transfer their heat energy explosively to the surrounding solid hydrided metal, where the explosions generate further cracks. When such a crack collides with the surface of a hydrided bubble, then the electrically charged bubble surface generates a strong electric field within the crack. Again, the electric field accelerates hydrogen nuclei from the bubble until they get several kilo-electron-volts of energy. Hence, a cycle reaction of the creation of cracks, electric fields, kilo-electron-volt hydrogen nuclei, hot spots, and micro-explosions is generated. This cycle reaction might result in the pulverization and even explosion of the entire metal hydride.

If the hydrogen isotope deuterium is used, then this cycle reaction is accompanied by fusion reactions. These fusion reactions occur when the kilo-electron-volt deuterons reach the other crack side and fuse with the non-accelerated deuterons of the weaker hydrided metal. This cycle reaction which includes deuteron fusion reactions is called the “extended micro hot fusion scenario”. This scenario was suggested by Roman Sioda and me [9, 11]. It is able to explain the neutron emissions reported by Jones et al. [3, 4], the neutron bursts reported by De Ninno et al. [12, 13] and Menlove et al. [14, 15], the simultaneous heat and neutron bursts reported by Gozzi et al. [16, 17], and the explosions of cold fusion cells reported by Fleischmann et al. [5].

The experimental evidence for the extended micro hot fusion scenario is presented in the table.

Table: Cold Fusion Phenomena which Can Be Explained by Extended Micro Hot Fusion

| No. | Phenomenon | Explanation |
|-----|--|---|
| 1 | Emission of 2.5 MeV neutrons [3, 4, 18-24] | Deuteron-deuteron fusion $d(d, n)^3\text{He}$ |
| 2 | Emission of 3.0 MeV protons [25-27] | Deuteron-deuteron fusion $d(d,p)t$ |
| 3 | Near-surface process for palladium [3, 4, 9, 28] | Crack-formation near palladium surface [29] |
| 4 | Deuterium gas emission [30, 31] | Gas desorption by crack formation [9] |
| 5 | Acoustic emissions simultaneously with neutron [32, 33] and proton bursts [34] | Relaxation of metal lattice by crack formation [35] |
| 6 | Radio emission simultaneously with proton bursts [34] | Formation of high electric fields within the cracks [35] |
| 7 | Disappearance of neutron emission several hours after the start of electrolysis [3, 4, 18, 19, 36] | Bubble growth time is between 0.1 sec and 1 day [37]; fracture time is several hours [38] |
| 8 | Emission of $10^{*4} \dots 10^{*7}$ neutrons per cm^{*3} of electrode material (many experiments where neutrons have been | Calculation: Refs. [37, 38] |

| | | |
|----|---|---|
| | detected) | |
| 9 | Ratio of 100 emitted neutrons per Joule liberated [16, 17, 30, 39, 40] | Only 1 of 10^{12} of the keV deuterons undergoes fusion reactions [11] |
| 10 | Heat emission from light hydrogen loaded cells [41] | Formation of bubbles, cracks and electric fields is independent of the hydrogen isotope used |
| 11 | Emission of keV electrons [42-46], positively charged keV ions [43, 47], X-rays [48-51], radio-waves [44] and electrification [52, 53] from various hydrided materials and neutron emission [1, 2, 54, 55] from deuterided materials minutes after mechanical treatment | Fracto-emission by formation of strong electric fields with $10^7 \dots 10^8$ V/cm and $10^4 \dots 10^5$ V [1, 2, 50, 56] |
| 12 | Many non-successful experiments [57-87] | Various possible explanations including [9, 88-90]: (a) too low sensitivity of detectors; (b) electrodes had long pre-loading times and measurements were performed only after the termination of the emissions |

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