# CONTROLLED RELEASE OF STORED ENERGY IN METALS

## RESULTS OF PRELIMINARY MECHANICAL-THERMOGRAPHIC TESTS CONDUCTED AT THE ROYAL SCIENTIFIC SOCIETY, AMMAN, JORDAN

October 22, 1990

## 1. INTRODUCTION

Preliminary experiments to release internally stored energy in metals were conducted at the Royal Scientific Society (RSS) in Amman, Jordan on October 22, 1990. By varying test parameters, hot-spots ($38^{\circ}C$ above ambient, see Fig. 2) were measured and recorded on the fractured surfaces of carbon steel samples. The tests demonstrated the propensity of metals to liberate heat due to mechanical work, or the-work-of-fracture, Reference 1. The formation of cracks, voids, and other defects in electrodes used in the "cold fusion" process has already been confirmed in the United States, Japan, and elsewhere.

The preliminary experiments demonstrated the capability of existing facilities at the Royal Scientific Society and the proficiency of its human resources to conduct formal test programs to develop specific methods to harness the latent heat in metals. Progress in the understanding of the solid state of matter will also be achieved from the test and study programs.

The advantage of energy storage in metals can be seen from a comparison of the heat content of, say, coal, which is less than 10 kcal per cubic centimeter, to the heat liberated in the Pons-Fleischmann cold fusion process, of more than 1,000 kcal from a comparable metal cube: A 100:1 volume advantage. Extracting a fraction of this potential can alter the future energy alternatives in the world.

## 2. OBJECTIVES

The experiments were preliminary in nature, and were conducted during the UNDP's sponsored TOKTEN (Transfer of Know-how Through Expatriate Nationals) mission of Ali F. AbuTaha to the Hashemite Kingdom of Jordan, and under the auspices of the Royal Scientific Society. The goals of the experiments included:

a. To demonstrate whether formal, and scientifically controlled, test programs can be conducted at the RSS facilities to measure the propensity of metals to liberate heat through mechanical work.

b. To measure the quantity of heat that can be produced by the fracture of metals.

c. To demonstrate how the quantity of heat can be controlled by varying test parameters, for example, strain rate, force, etc.

## 3. BACKGROUND

On the basis of research and tests conducted by Professors Stanley Pons and Martin Fleischmann at the University of Utah, the possibility of nuclear fusion at room temperature (cold fusion) was announced in March 1989. Considerable heat was liberated from a palladium (Pd) sample in a simple electrolytic set-up: Pd and Pt electrodes immersed in heavy water and connected to a small battery. While conventional nuclear fusion research has not yet achieved breakeven, comparison of the output and input in the cold fusion process made it appear that 1,000% of breakeven was achieved, and that 1,000,000% was possible.

Many international teams attempted to duplicate the Pons-Fleischmann results. Some succeeded to liberate heat from the simple set-ups, while others did not. The same was true of fusion by-products, the release of neutrons and tritium. Here, the results were minimal, variable, inconsistent with theory, or non-existent.

A Workshop was sponsored by the U.S. Department of Energy (DOE) and the Los Alamos National Laboratory in Santa Fe, New Mexico, May 22-24 1989. More than 200 scientific papers were presented by scientists from many countries. A. F. AbuTaha presented two papers, Cold Fusion - The Heat Mechanism and Cold Fusion - Engineering Perspectives. These works were unique in that they:

a. Identified palladium, and not deuterium, to be the fuel in the process.

b. Showed that the conversion of mechanical energy was responsible for the liberation of heat.

c. Identified hydrogen (or deuterium) embrittlement as the triggering mechanism for the mechanical work, or energy.

d. Anticipated that the propagation of cracks in the Pd electrodes was responsible for the phenomenon, that the fully cracked Pd (or other metals or alloys) samples must be recycled, by melting, to restore the crystallographic structure which is necessary to continue the process, and that, hence, breakeven (100%) was not achieved from the process.

The experiments conducted at the Royal Scientific Society in Amman, Jordan, are the first of their kind and have demonstrated that considerable amount of heat can be produced by mechanical work on metals.

## 3. TEST SET-UP AND PROCEDURE

Standard tensile machine and thermography, video/infra-red (IR) data processing, camera unit were used in the tests. Carbon steel specimens were pulled apart, under different strain rates, to fracture. The IR processor unit first measured the sample ambient temperature before the test. The IR camera continued to view the fractured surfaces for several minutes after each test.

To reduce the effect of plastic flow, dislocations interaction, and other effects, and to emphasize the work-of-fracture at the fracture surfaces, brittle carbon steel specimens were selected for the tests. A notch was introduced into each sample to fix the fracture location within the view of the IR camera.

## 4. RESULTS AND DISCUSSION

DATA:

The following data were recorded for the six samples tested:

| Sample | Material | Strain Rate(mm/M) | Force (kN) | $T_i$ ($^oC$) | $T_f$ ($^oC$) |
|---|---|---|---|---|---|
| 1 | C-Steel | 160 | 336 | 27 | 47 |
| 2 | Brass | 23 | 87 | - | - |
| 3 | C-Steel | 160 | 296 | - | - |
| 4 | C-Steel | 277 | 364 | 26 | 55 |
| 5 | C-Steel | 277 | 302 | 31 | 59 |
| 6 | C-Steel | 277 | 404 | 26 | 64 |

Sample #5 was first buckled (in compression) and then pulled in tension.

OBSERVATIONS:

In all tests, distinct hot-spot(s) developed, and were recorded, on the fractured surfaces of the carbon steel specimen, Figure 1. The contours of the hot-spots persisted on the IR screen for several minutes, and until the next sample was readied for test.

The initial or ambient temperature ($T_i$) of the specimens and the final temperature ($T_f$) at the hot spots are plotted in Fig. 2. The Figure also shows the other conditions associated with each test.

Increasing the strain rate and/or the load to fracture increased the hot-spots' temperature and, hence, the quantity of heat involved in the process.

In all tests, the hot-spots persisted for several minutes, and the IR unit recorded slow dissipation of heat.

Conduction of heat from the two primary fracture surfaces and, possibly, from localized minute cracks in the bulk was also noted as each specimen became warm after the test. This temperature was not measured.

DISCUSSION:

The results and observations above warrant formal study of the phenomenon of controlled heat-release from metals. First, the experiments require refinements and formal procedures. It is noted that in studying the heat capacity, specific heat, molar heat capacity, and related thermodynamic parameters of solids, tests as those conducted at the RSS laboratories have not been done before. The mechanical equivalent of heat was skillfully developed in the experiments of Joule. Those classic experiments equated externally done work on a system to the quantity of heat generated by the mechanical work.

The formal test program, which is proposed to follow the preliminary experiments reported here, will lead to accurate determination of the internal energy content in metals and alloys through integrated mechanical-electrolytic-thermographic-nuclear measurements.

The proposed test program must be sufficiently and scientifically detailed to allow presentation of data and results in reputable international journals. The test program must aspire to determine the specific parameters to ignite, control, and terminate the heat-liberation process. This effort should lead to patentable discoveries and commercial benefits.

A tour of the RSS facilities and discussions with the scientists and engineers at the Society and the faculty of Science and Engineering in the Universities indicate that the formal study program in the Hashemite Kingdom of Jordan can be successful. The program will require

Mechanical-Thermographic (controlled tests as described above)
Mechanical-Calorimetric (to expand above tests)
Mechanical-nuclear (to count neutrons and other fusion by-products)
Metallurgical analysis and tests (to support the above and other tests).

The experiments described here were conducted at a short notice and in a limited period of time, and demonstrated the proficiency and quick turn-around that can be achieved.

## 5. CONCLUSIONS

The preliminary tests conducted at the Royal Scientific Society's laboratories in Amman, Jordan achieved the primary objectives summarized in Section 2 above. International sponsorship for formal test and study programs will be sought, accordingly.

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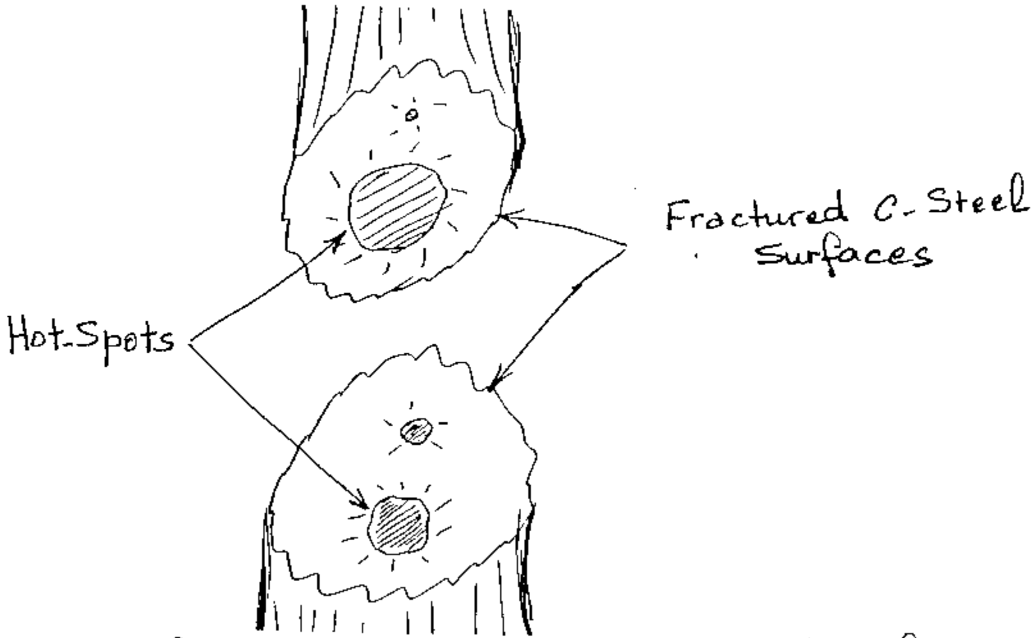


Fig. 1 Hot-Spots formed and recorded on Fractured Surfaces
(Substitute I.R. or video enhanced photos)

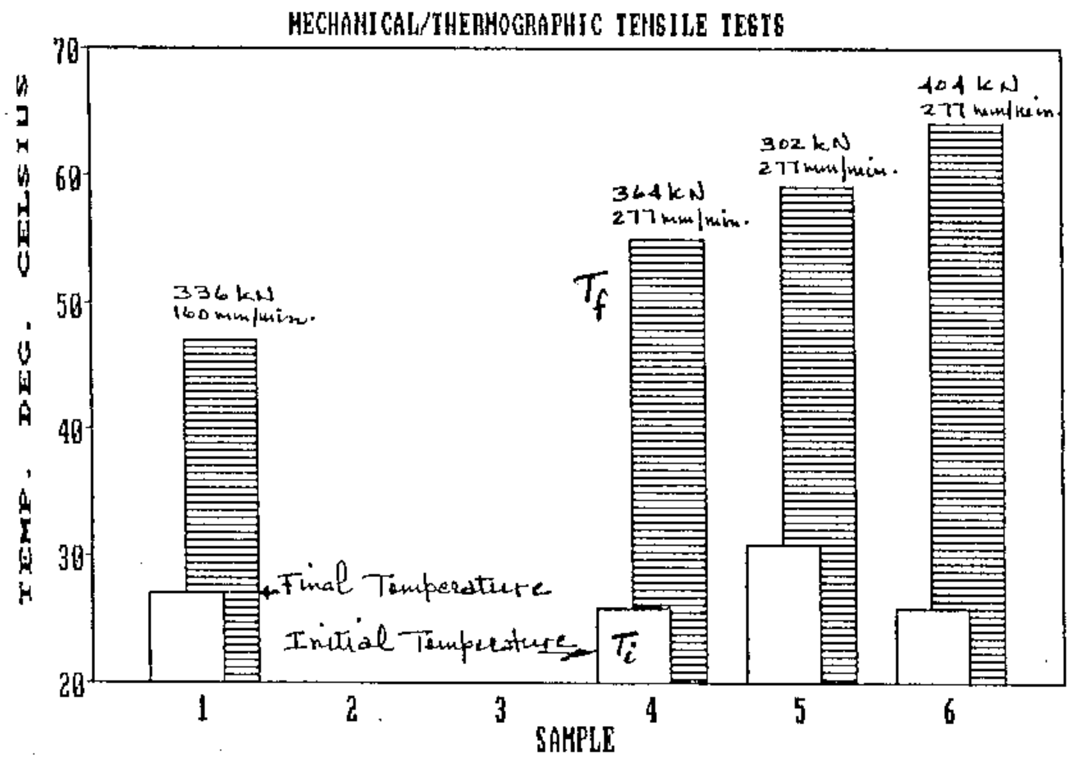


Fig. 2 Temperature Rise in Hot-Spots on Fractured Surfaces