COLD FUSION - A LOGICAL NETWORK APPROACH

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The great obstacles in the way of general acceptance and rapid development of cold fusion are: the difficult-to-comprehend diversity of systems, phenomena and results; the difficult-to-recognize difference from plasma hot fusion; and the most difficult-to-accept difficulty of both experiment and theory. A strategy, based on the author's surfdyn concept, on a breadth-first approach and on cooperation, is presented. The aim is to stimulate discussions on the subject `strategy' at the Symposium.

INTRODUCTION

During the time elapsed since its discovery, cold fusion has demonstrated three big `D's as follows:

a. DIVERSITY of the systems, phenomena, results - a first source of confusion.
b. DIFFERENCE from the `classical' hot plasma fusion: actually it is an entirely different class of nuclear phenomena,
c. DIFFICULTY both in reproduction of experiments and in finding a theoretical explanation, and further, an almost fatal source of confusion and disappointment.

These D's had a strong divisive effect on the scientific community. However, both the adepts and the adversaries of cold fusion resisted the assimilation of these unexpected facts and ideas. Actually, all these problems are unavoidable pains of birth characteristic for a new science which is much more extensive and novel than it was initially imagined.

Obviously, difficulty is the most difficult to accept and is the greatest drawback for a healthy, dynamic development of the field. To tackle hyperfine, hypercomplex, hypersensitive processes is a strategic task.[l] Therefore, only a synthesis, a prospective view, a breadth-first approach can solve the long range problems, i.e. to find correlation and unity in diversity, reason and vision in difference, explanation and cure for difficulty.

In this paper the author intends to present his offer for a strategy. Full objectivity cannot be warranted given the author's thinking is hypothesis-driven [2], however methodology is more important than any results. This Minsk Congress is (or has to be) an excellent opportunity to discuss seriously cold fusion strategy/alternative strategies and to line out the new paradigm.

It is worth mentioning that J. Dufour [3] has worked out an exemplary strategy for his important system and theory.

UNDERSTANDING DIVERSITY

If we include here the Siena University breakthrough [4] and Reifenschweiler's `ancient' experiment [5], there are at least ten different systems/devices which produced positive results of a kind or another.

For reasons of editorial economy, these won't be listed here, however we want to emphasize the following:

a) both devices with liquid/gas/solid and with gas/solid interfaces have been worked out;
b) all the hydrogen isotopes are active, cold fusion is not a privilege of deuterium.

For reasons of conceptual economy (Occam's razor) we have to admit that one and the same chemical environment opens the `windows of opportunity' for these nuclear reactions. The author, based on his hypothesis regarding the catalytic nature of these phenomena, and using the quasi-entirety of the published data, has arrived at the following conclusion: "The triggering factor in all cases is the contact of a hydrogen isotope with a surface having active sites with high concentration, very high localization, and ultra high mobility of the hydrogen isotopes. To attain this with a high global hydrogen/metal ratio (as e.g. in the Fleischmann-Pons or McKubre et al. cells) is a straightforward solution. However, to attain this without a high global H/Me ratio as in the light water/Ni cells, in the gas discharge, ozonizer-type, protonic conductors-based or sonofusion devices is a creative solution (at least from the point of view of the engineering)."

According to the size, density and activity of these catalytic centers, in a similar manner as for the heterogeneous catalysis, see e.g. [6], a great variety of reactions can be triggered. Understanding, prediction, and control of these processes is only fragmentary and partial yet. However, it is essential to classify them in precursors, primary, secondary, chain reactions. Recent trials to integrate these reactions with a logical taxonomy have been performed by Dufour [3] and Moon [7].

EMPHASIZING DIFFERENCE

The misunderstanding of cold fusion is, for the most part, due to the consequent but apparently useless trials to adapt the new data to the old paradigm of `classical' plasma hot fusion by diverse depth-first approaches. The result: weakness for the adepts, a weapon for the adversaries of cold fusion. Actually, the accumulating data show more and more convincing that the topology, nature, mechanism(s) of the two different categories of nuclear phenomena have little in common. In such circumstances, cold fusion produced excess of heat sometimes, excess of theories all the time (with Moon's words: "the mental barrier was even higher than the Coulomb barrier"). In the case of hot fusion, the latter barrier is violently penetrated, while in the case of cold fusion it is shrewdly (and humanly) bypassed. The mechanisms of these new nuclear reactions are still unknown, however this logical network approach tends to favor neutral-particles-mediated few-body interactions.

EXPLAINING DIFFICULTY

It is difficult to decide what is more damaging for the development of the field: lack of a theory or the difficult-to-reproduce behavior of the experiments. As a US-Russian team of eminent scientists has stated: "The problem of an adequate theoretical model of cold fusion has turned out to be no simpler than the problem of its unambiguous experimental proof" [8]. Is this a symptom of the pathological character of cold fusion? Surprisingly enough, the reverse is true. Our `foraging in neighboring areas'-type actions [1] performed with the aim of gathering inspiring information, have concluded that all the breakthrough fields of solid-state science scarcely have theoretical underpinnings. We refer here to: high-temperature super conductivity, conductive polymers, porous silicon, and heterogeneous catalysis, this last issue being considered by the author as directly bound to cold fusion. (An essay on this theme is generously distributed by ENECO at the Maui conference).

In the author's opinion, difficult reproducibility is inherent to the cold fusion systems in their pre-engineered form and catalysis (with its high sensitivity toward poisons) seems to be the only logical explanation for such a behavior. Catalysis seems to be the unique possibility to realize that positive and negative results are complementary and not contradictory.

In the systems where the three essential conditions (concentration, localization, mobility) are accomplished in a natural way, reproducibility is high. An example: the proton conductor devices, whose prototype was made at Ekaterinburg [9], with their crystalline capillary channels are based on smart nanostructured materials with maximal internal surface of the highest reactivity: these create an unique environment where the functions of the surface are enhanced to an unprecedented level. Therefore such forced-contact devices work well. If we accept the catalytic nature of cold fusion, the problem will become a part of the solution.

EXPLAINING CATALYSIS

The author is well aware that a theory or a hypothesis considering cold fusion as a form of catalysis is not welcomed by either those working in the new science or by the specialists in catalysis. For the former, the surface topology is usually unacceptable (despite the experimental data supporting a surface mechanism!), for the latter, the generation of MeV scaled effects by eV scaled causes seems to be impossible.

The root of the problem is the limited understanding of catalysis and the trend to restrict it only to chemical catalysis. Actually, catalysis is an essential phenomenon in nature and has diverse forms such as: nuclear, physical, chemical, biochemical, biological, intellectual, managerial, social catalysis. Important processes such as life, evolution, thinking, are based on catalysis.

Much beyond its primitive etymology (catalysis means dissolution), it is a cooperative dynamic action with two levels of organization of matter which makes impossible things possible. A recent example [10] shows how the coherent nuclear motions in a membrane protein explain the mechanism of photosynthesis, which is hence a nuclear-biochemical joint business. The `ancient' Philips experiment [5], is perhaps one of the first examples of a cooperative interaction of this type: here electrons and nuclei can work together due to the very small dimensions of the Ti particles which create a catalytic environment.

Catalysis and surface are issues of extreme complexity, therefore catalysis is more an art than a science [11], or in other words, for this discipline, which is over 170 years old, there is "a repeated phase shift of 20-40 years with technology starting first, followed by the evolution of scientific research" [12]. It seems that something analogous will happen to the 5-year old cold fusion. If this really is a catalytic process intimately (and causally) bound to the dynamical properties of the surface and near surface atoms, direct "in situ" and "in tempore" studies of the very mechanisms will be possible only by use of advanced methods as are just-now emerging electrochemical microscopy [13,14]. On the macabre side, any type of post-mortem (ex-situ) analysis will give limited information, given that the dynamic activity is lost.

CONCLUSION

Due to the immense theoretical and experimental problems, the future development of the new science and technology of cold fusion will be based mainly on know-how data and working hypotheses (as our SURFDYN). However, some fundamental theoretical issues as the nature of the reactions have to be explained in the near future. The keyword for this action just as for the essence of catalysis is

cooperation: both international cooperation and cooperation of the theories which have to be considered complementary and not contradictory. For example, the SURFDYN model has a lot in common with Filimonov's synergetic activation model (self-organization) [15] as well as with the catalysis by trapped neutrons of Mizuno [16] and so on... An efficient strategy has to rely on cooperation, in all the three meanings of this word used in this paper.

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