Truth of the Cold Fusion Phenomenon (CFP)

The science of the cold fusion phenomenon (CFP) is not established and we can not give a consistent explanation of the various events introduce in the "Facts of the Cold Fusion Phenomenon" given in this website. Therefore, there is no common understanding about what is the truth of the CFP.

Our explanation of the truth of the CFP in this paper is therefore our subjective concept on this problem based on our phenomenological approach which has given a unified explanation of the various events with a very large diversity in materials (CF materials) and in observed effects.

It is our understanding of the nuclear reactions that it is necessary to have very high energy up to several MeV to induce nuclear reactions between charged nuclei and therefore it is not possible to explain the facts obtained in CF materials by nuclear reactions between charged nuclei. Only one possibility to explain them is given by participation of neutrons as assumed in our TNCF model (trapped neutron catalyzed fusion model) [Kozima 1998, 2006].

We cite here two sentences from our previous book [Kozima 2006 (Epilogue)] and paper [Kozima 2014a (Conclusion).

"Epilogue – CFP as a Typical Complexity in Hydrated Solids

Science is a human endeavor which began late in the history of civilization. Its activity resides in a thin surface layer of our brain, supported by fundamental, old and instinctive activities in deep in the brain. Reason is one of the characteristics of human beings, together with others such as righteousness and sensibility. Rationalism, an essential part of science, is a subtle activity governed by emotional movements deep in the brain. Pascal's words express it briefly; "Man is but a reed, the weakest in nature, but he is a thinking reed." (B. Pascal, Pensées, 347)

Scandalous events which occurred in connection with the discovery of the cold fusion phenomenon (CFP) were results induced into the scientific world by an underlying old world, as described in greaqt detail by G. Taubes. However, it is shortsighted to conclude that the essence of CFP is fraud from the tragicomedy played by actors controlled by secular desire and a lack of knowledge. It is similar to the fact that I.

Newton's controversy with G.W. Leibniz about the discovery of differential calculus does not spoil his accomplishments.

Consider an example of confusion, which tends to occur during a crisis concerning a new paradigm. The DOE Report of 1989 and the subsequent book by Huizenga, chair of the committee that presented the Report, did not have the foresight to look beyond the limits imposed by the established scientific world. Opponents of CFP were similarly behaved after the Report, and several scientific papers that denied the possibility of Fleischmann's hypothesis were published.

On the other hand, proponents were mired in established scientific theory the same as opponents. They adhered to an old frame of reference and used questionable assumptions to change reaction probabilities of d-d fusion in order to reconcile several uncertain tiny parts of a vast number of facts. These trials remind us of the Lorenz contraction devised to reconcile the result of the Michelson-Morley experiment with classical mechanics instead of the revolutionary assumption proposed by Einstein of the constancy of the speed of light for every reference frame.

If we consider the whole experimental data sets as results of a common cause about which we do not yet understand, it is clear that Fleischmann's hypothesis contradicts not only the experimental facts cited, but also other diverse facts discovered one by one since 1989. The merit of CFP is in its revolutionary capability of generating nuclides that, in free space, are only generated with reactions between high-energy particles.

The first step to approach a difficult problem is traditionally phenomenological. According to this common practice, we used a model to investigate CFP based on experimental facts that are not understood. We used a frame of reference established in nuclear physics and solid-state physics at that time (1993). When the model seemed successful, the next step was to check its capabilities to deal with as many facts as possible. The results of this work were successful. This gave us confidence that the fundamental premises of the TNCF model are effective and the trapped neutrons may reflect at least some of the reality behind the experimental facts of CFP.

By investigation of existing knowledge from the point of view suggested by the success of the TNCF model, it became clear that there are many riddles in the solid-state physics of transition-metal hydrides and also in the nuclear physics of excited states of

neutrons around the zero level (or the evaporation level). Together with this knowledge of riddles in traditional branches of physics, new facts of the CFP gave us direction to develop new physics of neutrons in solids. Tentative estimation of neutron bands below zero mediated by interstitial hydrogen isotopes and coherent accumulation of neutrons at surface/boundary regions gave us hope to clarify the riddle of the CFP which is unbelievable from the traditional point of view in physics. In our opinion, the fundamental physics of the CFP may be explained by continuing research along this passway.

Another important phase of CFP is complexity. As was explained in Section 2.12, it is shown by experimental facts that one characteristic of the CFP is complexity. This is already expected from the structure of materials in which the CFP occurs. The fact revealed in Section 2.12 confirmed our expectation and made the image of the CFP clearer. Our research on the CFP must consider this fact.

Science is fundamentally autonomous and not necessarily related with practical applications. In any period of history, reason is the guiding principle of the evolution of a society even if it is merely an ideal which cannot be fully ralized. Science should esteem itself as an activity of reason, but it is not independent of application, as a matter of fact. However, we recollect an episode told about M. Faraday and his discovery of electromagnetic induction. It is said that a man asked him about the future applications of the electromagnetic induction which was displayed in public, as if his discovery was useless. Faraday replied to the man "what can you say about the future of a newborn baby?" It is desirable that the CFP is correctly understood by many people and they achieve satisfaction in their investigations using materials on hand.
The CFP is a phenomenon which includes diverse events which are applicable to various materials. Application, however, is also restricted by the characteristics of the phenomenon. The characteristics of CFP pointed out in this book should be seriously considered in regard to applications." [Kozima 2006 (Epilogue)]

"***Conclusions***

The cold fusion phenomenon (CFP) has been a controversial theme in the interdisciplinary region between solid state physics and nuclear physics. As has been shown above, the CFP observed in cf-materials containing hydrogen isotopes (deuterium or/and protium) is too complicated to be explained only by some simple extrapolations of knowledge established in solid-state nuclear physics (or condensed

matter nuclear science) developed in 20th century. If it is reflecting something real in entity not noticed before 1989, there should be a fundamentally new physics hidden under the cloud of various events observed in the CFP and in turn the physics should reveal the existence of new events in solid state physics and nuclear physics. Our effort in this field should also be in the direction to find out what we can say about these new phenomena reflected from the CFP in the traditional research fields of physics.

On the other hand, the TNCF model fairly successful to explain the CFP as a whole at present will serve as a first step in the right direction to the science of this new field. The model shows that the new physics should be a science including a new state of neutrons in cf-materials. Furthermore, if we notice that the CFP is characterized by complexity, we have to treat the cf-material, the superlattice composed of a host sublattice (host nuclei at the lattice points) and a proton (deuteron) sublattice (protons (deuterons) at the interstitials) as a whole taking into nuclear reactions among host nuclei and interstitial protons (deuterons).

From our point of view using a phenomenological approach [Kozima 1994, 1998, 2004, 2006], the idea of the cf-matter resembling to the neutron sea appeared in the investigation of the neutron star matter is the most hopeful entity having close connection with neutron physics developing in nuclear physics. We have a lot novel knowledge of neutron interaction in isolated exotic nuclei behaving differently from the traditional concept of nuclear force in the nucleus [Kozima 2014a]. Furthermore, when a nucleus is not isolated and connected with other nuclei through the super-nuclear interaction, nuclear force between lattice nuclei mediated by protons or deuterons at interstitials with wavefunctions extended over lattice points as figured out in our model, we may have a new perspective of neutron physics in hydrogenated solids resulting in new features of nuclear physics not found in isolated particles considered by now.

Some new materials supporting our model are presented in Appendix to supplement our explanation given in papers and books published before [Kozima 2006, 2008c] and briefly discussed their relation to the TNCF model.

In conclusion, the answer we can give to the question "What is the cold fusion phenomenon (CFP)?" is "It is a riddle" at present when we do not know the complete necessary and sufficient conditions for the CFP. If the science of the CFP is established on the line suggested by our phenomenological approach, the vista of future science as the physics of neutrons in hydrogenated solids is wide and endless. We can not overview its development in future correctly at present.

It should be discussed briefly possible applications of the CFP. The events observed in the CFP, e.g. excess energy production and nuclear transmutation, are naturally

considered to be used in commercial devices. There, however, remain several limitations for their effective application due to the essential characteristics of this phenomenon. One is the sporadicity of the events and another is the short durability of working cf-materials which has been shown as defects generated at the surface of cf-materials where have occurred events of the CFP. Furthermore, we have to care emergence of radioactive emissions of neutrons and charged particles in the cf-materials. The sporadicity of the events will be overcome if we know the necessary and sufficient conditions for the events by development of science of the CFP. The durability of the working materials will be improved by the science of the CFP or remedied by such a technical invention to replace new working elements regularly. The hazardous radioactivity could be prevented by appropriate protection facilities." [Kozima 2014a (Conclusion)]

References

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