Thermodynamic Theory of Cold Nuclear Fusion (C.N.F)

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A new discipline known as STATE-FIELD THEORY OF THERMODYNAMICS (S-F. TOT) had been established in the period (1979-1991) by Shu-I Liu [1-5] [10].

In the present paper, (S-F. TOT) was applied to set up a strict thermodynamic theoretical foundation for the problem of COLD FUSION [6-9].

(I) THE NEW SECOND LAW OF THERMODYNAMICS, THE (law of Coupling) = (LOC)

In article [10], the first law was used to prove the qualitative existence of entropy S ($dS = 0$, when $\delta Q_R = 0$) without knowing the dS equation. This makes it possible to establish a new second law of thermodynamics, the Law Of Coupling (LOC) [1] [2], which states:

FRONTIERS OF COLD FUSION

"It is impossible for a simple system to approach a high entropy state from a low entropy one with evolution of heat at the same time! " ..... (Liu's LOC)

This statement is identical with( ) its 3 branches (I) (II) (III) and 5 small branches as shown by (Liu's Branch Theory of LOC), Equation(I-1) wherein P Process)

Identity (LOC) ≡ (I-1)

- exothermic P WITHOUT ENTROPY INCREASE (I)
  - exothermic P WITH ENTROPY DECREASE } 1OC(I-1)
  - exothermic P WITHOUT ENTROPY CHANGE } LOC(I-2)
- entropy increase WITHOUT EVOLUTION OF HEAT (II)
  - entropy increase IN ENDOTHERMIC PROCESS } LOC(II-1)
  - entropy increase IN ADIABATIC PROCESS } LOC(II-2)
- (III) ADIABATIC SYSTEM WITHOUT ENTROPY CHANGE } LOC(III-1)

Cold Nuclear Fusion belongs to LOC(I-1):
(CNF) is an EXOTHERMIC PROCESS with ENTROPY DECREASE. ..... (I-2)

Entropy S is an extensive function, its value is

proportional to the number of moles (n): n=2 for the reactants (A+B); and n=1 for the product AB with mass defect:

$$\text{LOC (I-1)} \ldots \left\{ \begin{array}{l} \text{A+B--> AB with mass defect} \\ \text{(mass defect) ---> (heat < 0);} \\ S_{A+B} > S_{AB} \end{array} \right\} \ldots\ldots \text{(I-3)}$$

(II) DISSIPATION CRITERIA FOR COLD NUCLEAR FUSION (CNF):

It was proved by using LOC for the process of irreversible charging of an electric cell:

$$\{ \triangle Z_{TP} = - \underset{\sim}{A}' - \triangle^{A}) / \text{ mole} \} \ldots\ldots \text{(II-1)}$$

This is the first two laws of thermodynamics for this irreversible cell process wherein:

$$\left. \begin{array}{l} \triangle Z_{T.P} = \text{(increase of free energy)} \\ \quad \text{produced by the charging work} \\ \underset{\sim}{A}' < 0 \text{ done to the cell} \end{array} \right\} \cdots\cdots \text{(II-2)}$$

The meaning of the above two equations is:

Bra { In the process of charging, the work input to the cell, $\underset{\sim}{A}'$ is converted into the increase of free energy, $\triangle Z_{T.P} > 0$;
Due to IRREVERSIBLE NATURE of the process, the work input $\underset{\sim}{A}'$ cannot be completely converted

$$\left.\begin{array}{l}\text{into free energy increase } \overset{\cdot\cdot}{\triangle} Z > 0,\\ \text{PART OF } \overset{\cdot\cdot}{A}' \text{ IS DISSIPATED AS HEAT:}\\ \\ (\text{Heat Dissipation}) = \triangle^{A} > 0\end{array}\right\} \text{ket...} \quad \text{(II-3)}$$

The exists a (CRITICAL VALUE OF $\triangle^{A}$) $= \triangle^{A}_{c}$, such that the following (CRITERIA FOR CNF) hold:

$$(1)\begin{cases}\text{If: } \triangle^{A} \geq \triangle^{A}_{c},\\ \text{Then:}\\ \text{(CNF) occurs}\end{cases} ; (2)\begin{cases}\text{If: } \triangle^{A} < \triangle^{A}_{c},\\ \text{Then: (CNF)}\\ \text{cannot occcur}\end{cases} \quad \ldots\ldots \text{(II)-4)}$$

Equation (II-4) seems to explain the experimental facts published by some authors. However, more experiments are seriously needed, especially the method of experiment and treatment of the results need serious considerations.

REFERENCES

[1] Shu-I Liu: State-Field Theory for The Laws of Thermodynamics: (III) A New Second Law Of Thermodynamics: the Law of Coupling and Its Deductions For Reversible Processes. Progress in Physics, Chemistry and Mechanics (PPCM) Vol. 1 (1988), PP1-19.

[2] Shu-I Liu: State-Field Theory for the Laws of Thermodynamics: (IV) The Set of Inequalities for Co-terminal Pair of Processes from the New Second Law of Thermodynamics, The Law of Coupling. PPCM Vol. 2 (1990), PP6-25, Hunan Press of Science and Technology.

[3] Shu-I Liu and Meiying Wang: A Comparative Critical Analysis of the Deductions from the Two Carnot Theorems of Thermodynamics, PPCM Vol. 2 (1990) PP96-113

[4] Shu-I Liu: Complete Chinese Text of the Paper: From The New Second Law of Thermodynamics, The Law of Coupling, to dissipation Criteria in Both Directions of Electric Cell Processes. PPCM Vol. 3 (1992), Earthquake Press, Beijing.

[5] Shu-I Liu and Meiying Wang: Complete Chinese Text of The Paper: A New Second Law of Thermodynamics, The Law Of Coupling; The State Rule And Two Gas Models. PPCM Vol. 3 (1992), Earthquake Press, Beijing.

[6] M. Fleischmann and S. Pons, J. Electroanal. Chem. Interfacial Electrochem., 261 (1989) 301

[7] Xu-Wu An et al., Thermochimica Acta 183 (1991) 107

[8] M. Schreiber et al., The First Annual Conference on Cold Fusion, March 28-31, 1990 (Salt Lake City, Utah, U. S. A.), Conference Proceedings P44

[9] Zhongliang Zhang et al., AIP Conference Proceedings 228 (Anomalous Nuclear Effects in Deuterium/Solid Systems) Provo, UT. U. S. A. (1990)

[10] Shu-I Liu: State-Field Theory for the Laws of Thermodynamics: (I) Direction Uniqueness Theorem of Adiabatic Process Vector. Science Exploration, 1 (1987), PP1-12.