Role of the binding energy of electron of the hydrogen atom in Ni-H cold fusion

U. V. S. Seshavatharam
Honorary faculty, I-SERVE, Alakapuri, Hyderabad-35, AP, India.
Email: seshavatharam.uvs@gmail.com

S. Lakshminarayana
Dept. of Nuclear Physics, Andhra University, Visakhapatnam-03, AP, India.
Email: lnsrirama@gmail.com

Abstract

During Ni-H collisions, proton (of the hydrogen atom) combines with the Nickel nucleus and electron (of the hydrogen atom) combines with the Nickel electronic shell and forms Copper with no emission of alpha or beta or gamma rays. For mole number of such Ni-H atomic fusions, as hydrogen atom is losing its identity, binding energy of electron is converted into heat energy of ~1.3×10^6 joules. As the temperature of the system increases, more number of hydrogen atoms may fuse with more number of Nickel atoms liberating more heat energy. Selection of the target cold fusion atom seems to follow the condition: selected stable atom's Z+1 is a new stable element with odd atomic number. Fineness of the Ni powder may help H atoms to fuse with ease causing more number of Ni-H fusions.

1. Introduction

One can see the pathetic history and current golden status of Cold fusion or Low energy nuclear interactions (LENR) in the Wikipedia. These new interactions are exclusively based on 'excess heat generation' and are absolutely free from the currently believed alpha, beta and gamma radiations. Experts believe that, LENR could use 1% of the Nickel mined to produce current world energy at a price four times cheaper than coal. Joseph Zawodny, a senior research scientist with NASA 's Langley Research Center says: "It has the demonstrated ability to produce excess amounts of energy , cleanly , without hazardous ionizing radiation, without producing nasty waste". It is not a surprise to say that, very soon LENR will dominate all the current leading research areas of physics in the near future. Since 1989 many scientists proposed many interesting proposals for understanding the observed excess heat generation with various experimental setups [1-7].

E-CAT (Energy Catalyzer) seems to be the most promising apparatus in this regard [8,9,10,11]. It is invented and being developed by Andrea Rossi. E-CAT constitutes a metal tube filled with nickel powder and heated to a high temperature, preferably, though not necessarily, from 150 to 5000 C. Hydrogen is injected into the metal tube containing a highly pressurized nickel powder having a pressure, preferably, though not necessarily, from 2 to 20 bars. E-CAT has elicited a lot of interest in different parts of the world. In this paper authors proposed a simple model for understanding the confirmed Ni-H based excess heat generation in E-CAT.

2. E-CAT – the Low Temperature Quantum Fusion Phenomenon

LENR is unique in that it uses a small amount of energy to give eight times more energy in output - for each unit of energy used the Energy Catalyzer reactor produces 8 units of output. Also interesting is that no energy is lost in the reactor. In a third party inspection, the E-CAT subject to testing was powered by 360 W for a total of 96 hours, and produced in all 2034 W thermal [9]. In this context experts say:

1) Something "REAL" is happening and we are certainly dealing with a new source of energy.
2) There are efforts ongoing to explore the validity of the theories and the weak interaction theories suggest what the physics might be.

From current known physics point of view it is quite shocking, quite bitter and demands the need of review and revision of our known physical laws and concepts. Based on the principle of conservation of energy it is clear that, during LENR and Cold fusion some hidden and unknown energy is being coming out in the form of heat energy. From the well known nuclear fusion and fission reactions it can be possible to think that, that hidden energy may be in the form of binding of protons and neutrons of the atomic nucleus or may be in the form of binding of electrons and the protons of the atom. Since the observed LENR and Cold fusion reactions seem to free from the well known nuclear radiations, authors guess that, binding energy involved with electron and proton of Hydrogen atom may be playing a key role in Cold fusion/LENR/E-CAT. It is well known that, origin of the binding energy of electron in hydrogen atom is quantum mechanical, it can be suggested that, E-CAT or Cold fusion can be called as the 'Low Temperature Quantum Fusion Phenomenon' [12].

3. Estimating the possible liberated heat energy in E-CAT

Let us guess that, under permissible safe operating conditions like safe working temperature, safe operating pressure, melting point of Nickel etc – 'somehow' proton of the hydrogen atom combines with nucleus of the Nickel atom and 'somehow' electron of the hydrogen atom combines with the electronic structure of the Nickel atom and thus ${}^{62}_{28}\mathrm{Ni}$ transforms to stable ${}^{63}_{29}\mathrm{Cu}$. Here the word "somehow" can be related with collisions in between Nickel atom and the hydrogen atom or some unknown reasons. If so, maximum possible liberated heat energy can be estimated as follows.

For one successful conversion of Ni to Cu, liberated heat energy is equal to the binding energy of one electron = 13.6 eV.

For n successful conversions of Ni to Cu, liberated heat energy is equal to the binding energy of n electrons = $13.6n$ eV.

For mole successful conversions of Ni to Cu, liberated heat energy is equal to the binding energy of mole electrons = $13.6N_A$ eV.

In general, the number of successful collisions of Ni-H will depend on the quantity of Ni powder, fineness of the nickel powder, working temperature, working pressure and volume of the E-CAT, kinetic energy of Nickel and Hydrogen, unknown catalyst, efficiency of the apparatus etc. Keeping all these parameters in view let us guess that $n \cong f \cdot N_A$ where $f \approx \frac{1}{1000}$ to 1 and can be called as the working factor.

For one successful conversion of Ni to Cu in one second, liberated power is equal to the binding energy of one electron per second = 2.17896×10^{-18} J/sec.

Considering the working factor, for $n \cong f \cdot N_A$ successful conversions of Ni to Cu in one second, liberated power is equal to the binding energy of $n \cong f \cdot N_A$ electrons per second = $2.17896\times10^{-18}\left(f \cdot N_A\right)$ J/sec $\cong 1.3122\times10^{6} f$ J/sec.

If $f \approx 1$, for $n \cong N_A$ successful conversions of Ni to Cu in one second, liberated power is equal to the binding energy of $n \cong N_A$ electrons per second = $2.17896\times10^{-18} N_A$ J/sec $\cong 1.3122\times10^{6}$ J/sec.

If $f \approx \frac{1}{100}$, for $n \cong \frac{N_A}{100}$ successful conversions of Ni to Cu in one second, liberated power is equal to the binding energy of $\frac{N_A}{100}$ electrons per second = 1.3122×10^{4} J/sec.

If $f \approx \frac{1}{1000}$, for $n \cong \frac{N_A}{1000}$ successful conversions of Ni to Cu in one second, liberated power is equal to the binding energy of $\frac{N_A}{1000}$ electrons per second = 1.3122×10^{3} J/sec.

If $f \cong \sqrt{\frac{1}{1000}\times\frac{1}{100}} \cong 0.003162$, for $n \cong 0.003162 N_A$ successful conversions of Ni to Cu in one second, liberated power is equal to the binding energy of $0.003162 N_A$ electrons per second = 4150 J/sec.

In this way, in a bold procedure, output of E-CAT can be understood. Independent of proton-neutron decay concepts and by considering a characteristic binding energy constant of the order of 13.6 eV, with this procedure LENR excess heat energy (that is free from all kinds of nuclear radiation) can be studied.

4. Selection criteria for the atoms of cold quantum fusion

Selection criteria for the atoms of cold quantum fusion can be understood in the following way.

1) Selected atom's fineness in its powder form. Fine powder may help in increasing the number of collisions between the selected atom and hydrogen atom.
2) Selected stable atom's Z+1 is a stable atom with odd atomic number. If ${}^{62}_{28}\text{Ni}$ is selected then after transformation, it becomes ${}^{63}_{29}\text{Cu}$.
3) High melting point of the selected atom which may help in increasing the working temperature of Cold fusion.
4) Selected stable atom's Z+1 is a stable atom with even atomic number. Heavy stable atoms having high melting point can be selected with this idea. If ${}^{106}_{46}\text{Pd}$ is selected then after transformation, it becomes ${}^{107}_{47}\text{Ag}$.

5. Conclusions

So far no model is successful in understanding and estimating the energy liberated in Cold fusion phenomenon. Considering the proposed concepts, it is possible to fit, estimate and design a cold fusion based apparatus. With further research and analysis basics of 'cold fusion' can be established.

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